Berks County

Hazard Vulnerability Assessment and Mitigation Plan Update

May 2024

BERKS COUNTY HAZARD VULNERABILITY ASSESSMENT AND MITIGATION PLAN UPDATE

PREPARED FOR

BERKS COUNTY DEPARTMENT OF EMERGENCY SERVICES
DIRECTLINK TECHNOLOGY CENTER
2561 BERNVILLE ROAD
READING, PENNSYLVANIA 19605

PREPARED BY

SKELLY AND LOY
A Terracon Company
449 EISENHOWER BOULEVARD, SUITE 300
HARRISBURG, PENNSYLVANIA 17111

MAY 2, 2024

JN227087

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS
(CONTINUED)

PAGE

TABLE OF CONTENTS
(CONTINUED)

PAGE

TABLE OF CONTENTS
(CONTINUED)

PAGE

TABLE OF CONTENTS
(CONTINUED)

PAGE

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

1.1 BACKGROUND

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 promulgated new regulations in the Federal Register at 44 CFR Part 201. These regulations clearly establish the hazard mitigation planning criteria for state, tribal, and local plans. According to Section 201.1(b) of the regulations, 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 planning guidance 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.

1.2 PURPOSE

Given the above law, regulations, and policies, the Berks County Commissioners decided to prepare this multi-jurisdictional Hazard Mitigation Plan for the County's 72 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.

1.3 SCOPE

Adoption of this plan by Berks County and its municipalities will not only allow each municipality to be eligible for disaster mitigation grant funds, it will 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.

The mitigation planning regulations at 44 CFR Part 201.6(d)(3) state that a local jurisdiction must review and revise its plan to reflect development changes, progress of local efforts, and priority changes within five years in order to remain eligible for grant funding. This update must undergo the same approval process as the original plan. FEMA recently issued a new guidance document that was referenced for this plan update which includes updated information on the local mitigation planning requirements. That guidance document is titled *Local Mitigation Planning Policy Guide* (FP 206-21-0002, April 2022).

1.4 AUTHORITY AND REFERENCE

Authority for this plan originates from the following federal sources:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C., Section 322, as amended
- Code of Federal Regulations (CFR), Title 44, Parts 201 and 206
- Disaster Mitigation Act of 2000, Public Law 106-390, as amended
- National Flood Insurance Act of 1968, as amended, 42 U.S.C. 4001 et seq.

Authority for this plan originates from the following state sources:

- Pennsylvania Municipalities Planning Code of 1968, Act 247 as reenacted and amended by Act 170 of 1988
- Pennsylvania Stormwater Management Act of October 4, 1978. P.L. 864, No. 167
- Pennsylvania Emergency Management Services Code. Title 35, Pa C.S. Section 101

Additional references used to prepare this document can be found in the appendices.

2.0 COMMUNITY PROFILE

2.1 GEOGRAPHY AND ENVIRONMENT

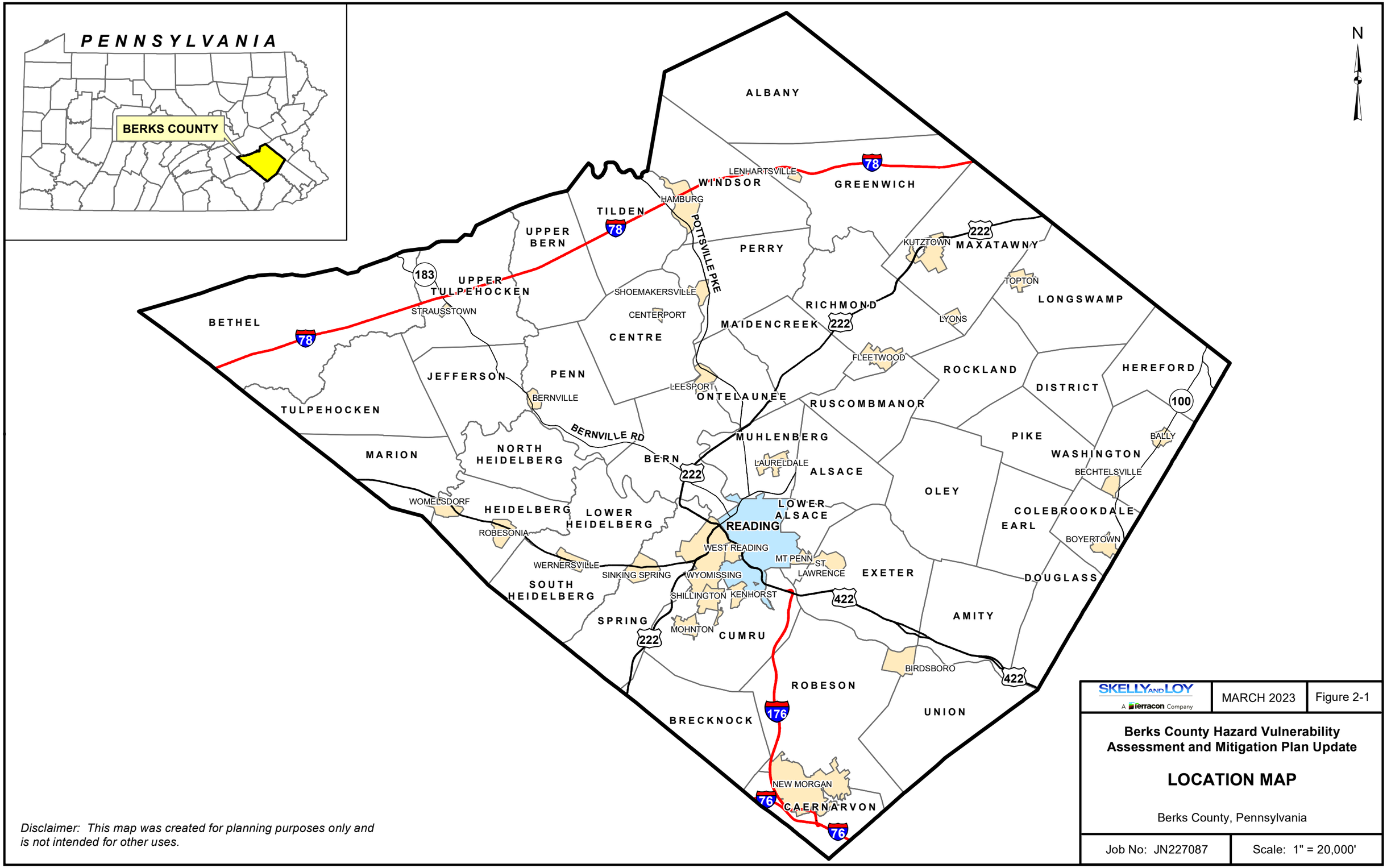
Incorporated in 1752 from parts of Lancaster, Chester, and Philadelphia Counties, Berks County is a diamond-shaped area of 864 square miles, situated in southeastern Pennsylvania (see Figure 2-1). An urban area of 428,849 persons (2020 Decennial Census), the County seat (Reading) is 56 miles northwest of Philadelphia. The County (a third-class county) is made up of 72 incorporated municipalities, 44 townships, 27 boroughs, and 1 city. Although broad-based, the Berks County economy reflects its historical development, with agriculture, health care, and manufacturing continuing to play important economic roles in the County. As of July 2022, Berks County contains the second highest number of preserved farms in agricultural easements (790) within Pennsylvania, which is significant given the growth in warehouse facilities.

2.1.1 Geology

The chronology of Berks County's Geology includes the Precambrian Eon and the Cambrian, Ordovician, Silurian, Triassic, and Jurassic Periods (see Figures 2-2 and 2-3). Karst geology exists within the northern and northwestern portions of Berks County's Ordovician Period as well as the Cambrian Period Formations. Blue Mountain bounds the northern boundary of Berks County and is underlain by the Sulurian period of geology. Blue Mountain contains the highest elevation in Berks County at 1,615 feet above sea level and is located at the Pinnacle formation in Bethel Township.

2.1.2 Climate

Berks County receives an average of 47 inches of rain per year and 21 inches of snowfall per year. The number of days with measurable precipitation totals 112 days. The average high temperature for July is 85 degrees Fahrenheit, and the average low is 21 degrees Fahrenheit. Berks County experiences an average of 203 sunny days per year.



Disclaimer: This map was created for planning purposes only and is not intended for other uses.

SKELLY AND LOY, A ferracon Company	MARCH 2023	Figure 2-1

Berks County Hazard Vulnerability Assessment and Mitigation Plan Update

LOCATION MAP

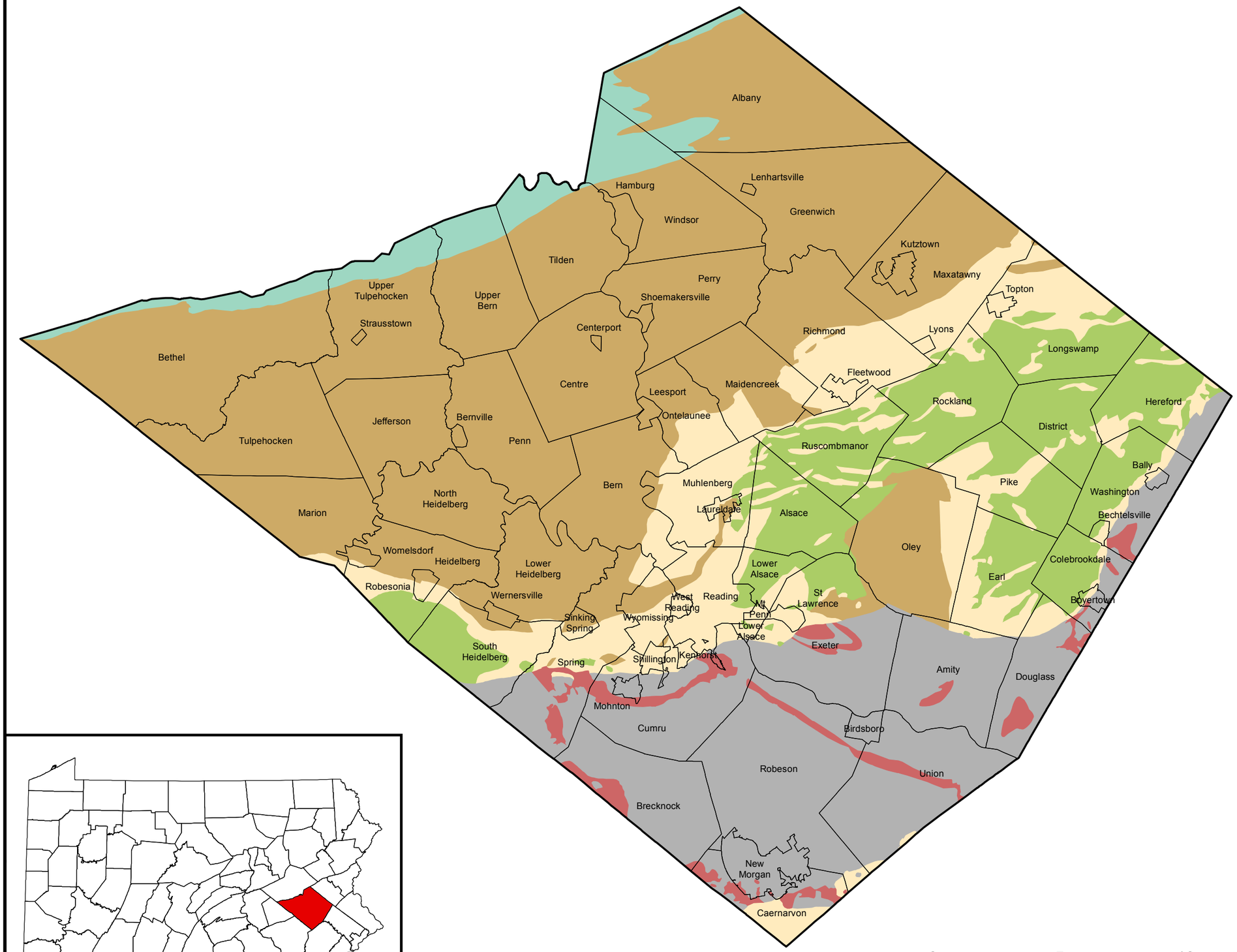
Berks County, Pennsylvania

Job No: JN227087	Scale: 1" = 20,000'

FIGURE 2-2

Berks County Comprehensive Plan Update
Adopted: September 2013

Geology
Berks County, Pennsylvania



0 5 10 Miles

N
W E
S

Legend

- Berks County Boundary
- Municipal Boundaries

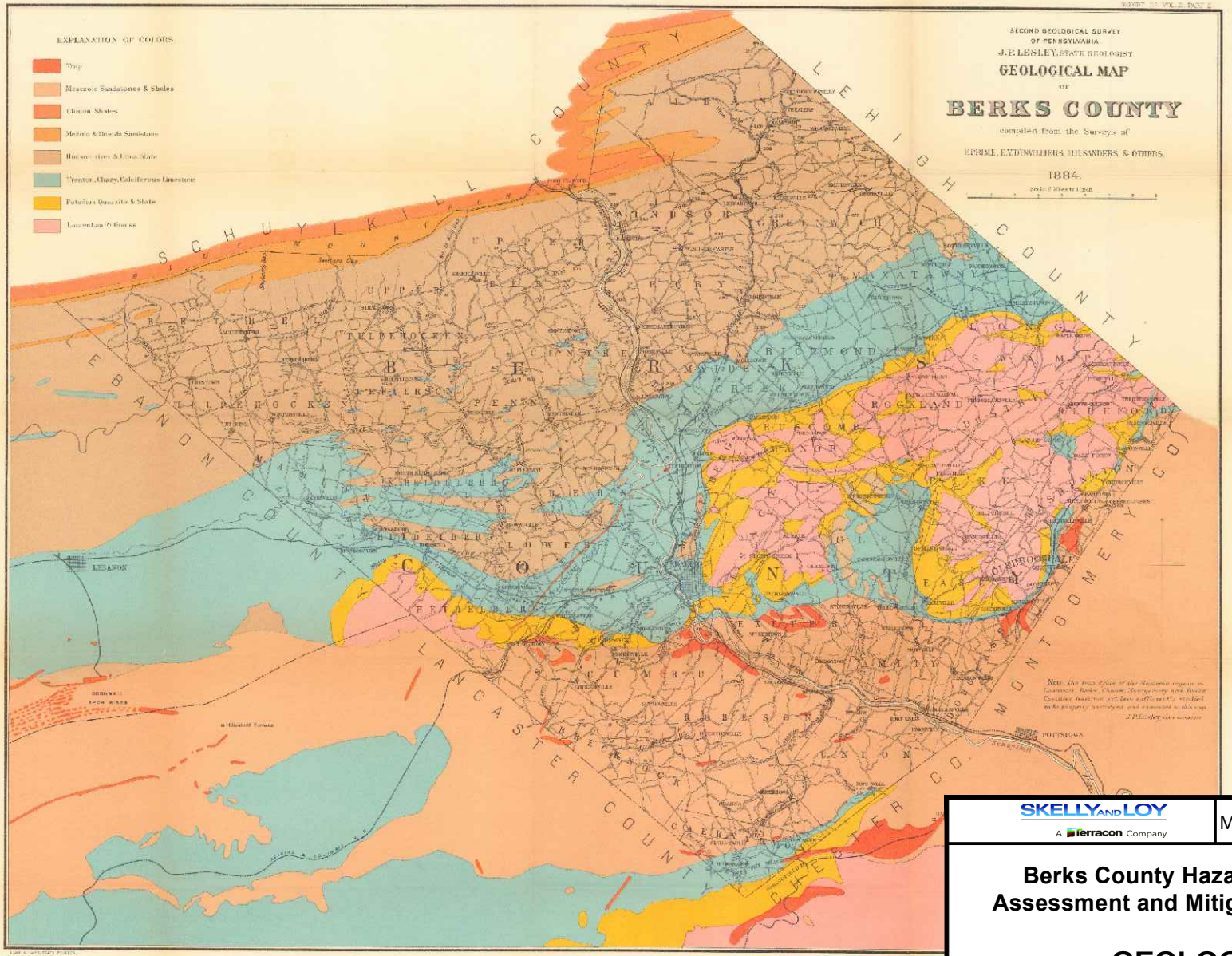
Geologic Period

- Precambrian
- Cambrian
- Ordovician
- Silurian
- Triassic
- Jurassic

Source: Berks County Planning Commission, Berks County GIS, Berks County Mapping, Pennsylvania Bureau of Topographic and Geologic Survey, Department of Conservation and Natural Resources

Published by the Berks County Planning Commission BAB 9/13

www.countyofberks.com/planning



SKELLY AND LOY A terracon Company	MARCH 2023	Figure 2-3

Berks County Hazard Vulnerability Assessment and Mitigation Plan Update

GEOLOGIC MAP

Berks County, Pennsylvania

Job No.: JN227087	Scale: Not to Scale

2.2 COMMUNITY FACTS

Unemployment rates for Berks County as of June 2022 (Pennsylvania Department of Labor and Industry Center for Workforce Information and Analysis) confirmed the County has a 4.6% unemployment rate (or 9,700 persons), which is equal to that of Pennsylvania (4.6%, or 298,000 persons). Berks County is currently nearing a return to pre-COVID numbers since the unemployment rate spiked during the 2020 pandemic. The labor force represents 209,500 persons in Berks County. Review of available online job postings from May 2021 to May 2022 indicate an increase in online job postings by 53.5%. The top ten Berks County employers during the fourth quarter of 2021 are listed below.

- East Penn Manufacturing Company
- Reading Hospital - Tower Health
- Amazon.com Services Inc.
- Wal-Mart Associates Inc.
- Carpenter Technology Corporation
- Reading School District
- County of Berks
- Penske Truck Leasing Co LP
- Boscov's Department Store LLC
- State Government

2.3 POPULATION AND DEMOGRAPHICS

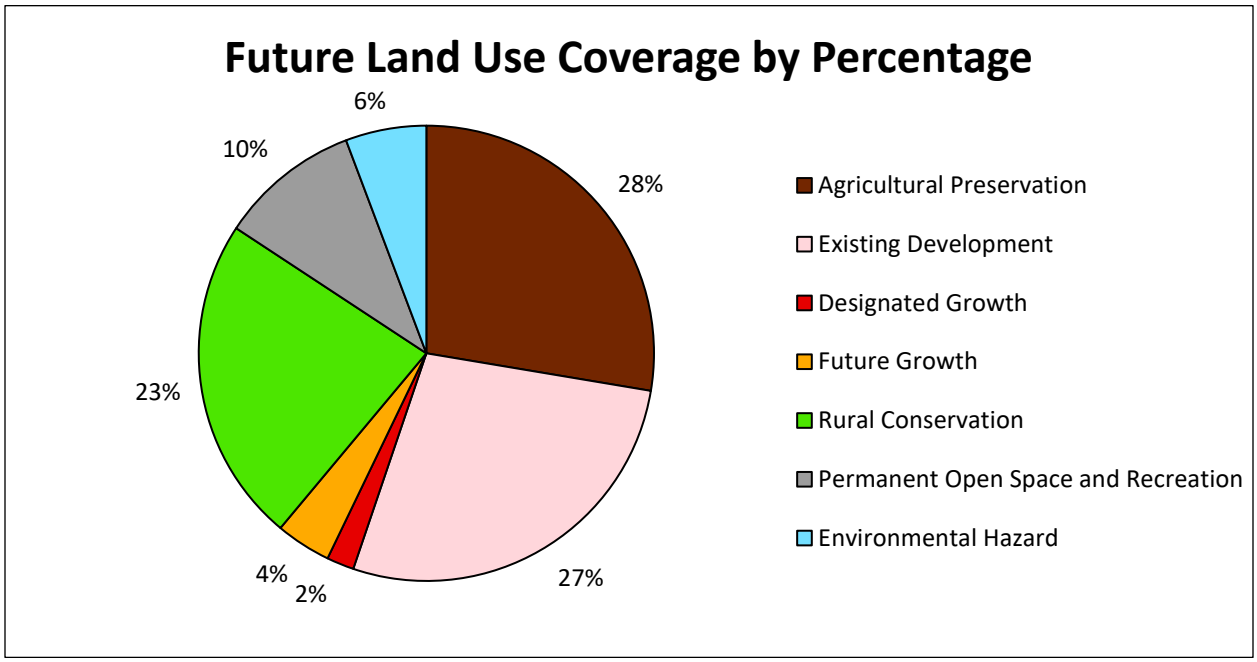
The 2020 United States Decennial Census identifies the Berks County population at 428,849 persons. The majority (72%) identify their race as white alone, not Hispanic or Latino, while 23% identify themselves as Hispanic or Latino and 5% identify themselves as Black or African American.

2.4 LAND USE AND DEVELOPMENT

The Berks County Comprehensive Plan 2030 Update was referenced for current land use patterns and future development. Similar to the Hazard Plan, the Comprehensive Plan breaks the County into five planning districts, as seen in Table 2-1 below. While the majority of land use (28%) consists of preserved agricultural land, existing development follows a close second at 26%.

TABLE 2-1
FUTURE LAND USE OF BERKS COUNTY

	HAWK MOUNTAIN (ACRES)	OLEY HILLS (ACRES)	SOUTHERN HIGHLANDS (ACRES)	TULPEHOCKEN (ACRES)	METRO (ACRES)	COUNTY TOTAL (ACRES)
Agricultural Preservation	72,595	19,518	9,907	51,931	244	153,295
Existing Development	22,064	29,370	27,754	16,255	30,809	126,252
Designated Growth	1,715	2,244	3,484	1,263	2,063	10,769
Future Growth	6,804	1,601	6,013	5,516	1,849	21,783
Rural Conservation	28,880	44,670	24,055	16,913	14,062	128,580
Permanent Open Space and Recreation	22,324	1,854	13,347	10,933	7,022	55,480
Transportation Network	6,376	3,950	4,752	3,916	7,644	26,638
Environmental Hazard	8,948	5,514	6,537	6,431	4,392	31,822
Region Total	169,706	108,721	94,949	113,158	68,085	554,619



The County is challenged to find ideal locations for development along the Interstate 78 corridor, which is a major thruway in the northern portion of the County, located amongst fertile agricultural land. As part of the Berks County Comprehensive Plan 2030 Update, 14,571 acres were identified for preserving prime industrial and commercial land. Future development of Berks County was identified to encompass 32,552 acres to accommodate the majority of the new residences, businesses, and institutional uses.

2.5 DATA SOURCES AND LIMITATIONS

Sources used to compile the information found in Section 2.0 include the *Berks County Comprehensive Plan 2030 Update,* United States Census Bureau, Weather Underground, and Penn State Library online geologic map collections.

3.0 PLANNING PROCESS

3.1 UPDATE PROCESS SUMMARY

The regulations intend that the approved plan update will serve as a stand-alone complete and current plan, not as an amendment to the original document. The plan update must provide information on the progress to fulfill the commitments and activities intended to be implemented through the adoption of the previously approved plan.

The plan update includes all newly identified hazards as well as more detailed information on existing hazards where it became available. Information for the plan update was gathered using the same resources utilized during the original plan development process, including review of available mapping from local and state agencies, review of municipal planning documents, and coordination with Berks County Department of Emergency Services (DES) staff and municipal representatives. The latest available Geographic Information System (GIS) data were obtained from Berks County Planning as part of this update.

By evaluating each municipality to determine what commitments were met, the plan update was able to better identify goals and objectives as well as to re-prioritize some activities.

3.2 THE PLANNING TEAM

Berks County DES was responsible for the development and coordination of this Hazard Mitigation Plan. To accomplish this task, Berks County DES formed a Mitigation Steering Committee comprised of representatives from FEMA, 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. For the 2012, 2018, and 2023 updates, the Mitigation Steering Committee was reconvened with several of the same members participating. The Mitigation Steering Committee met on a bi-monthly basis during the development of the plan for the 2012 update. For the 2018 update, the Mitigation Steering Committee met on a monthly basis as part of the plan update. Likewise, for the 2023 update, the Mitigation Steering Committee met on a monthly basis.

3.3 MEETINGS AND DOCUMENTATION

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 original 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.

Two public meetings were also completed as part of the 2012 plan update. Both of these meetings were conducted at the Berks County Fire Training Center and were held on May 1 and November 15, 2012. Documentation of these public meetings is also included in the appendices.

As part of the 2017 update, a similar public meeting format was completed. Berks County DES completed public meeting advertisements in the Reading Eagle newspaper along with advertising on the Berks County DES website and Berks County Facebook page. The first series of public meetings were completed August 8 and 10, 2017. The August 8 meeting was held at the Penn State Berks campus, and the August 10 meeting was held at the Kutztown University campus. Public participation was summarized on the surveys included in Appendix B. The meetings served as an update to what would be included in the 2017 Hazard Mitigation Plan.

The third public meeting was held on January 24, 2018, as part of the final public participation for the plan update. The meeting was held at Alvernia University. Similar to the first series of public meetings, public participation was summarized.

As part of the 2023 update, Berks County DES attended public events and festivals around Berks County rather than holding public meetings. The events included the Muhlenberg River Fest on August 26, 2022; West Reading Fall Festival on September 17, 2022; Berks County Heritage Center Museum Day on September 17, 2022; Berks County Heritage Center Country Store weekends on September 24 and 25, 2022, as well as October 1 and 2, 2022; and Berks County Heritage Center Gruber Lantern Tours and Night Hike on October 7, 2022 (Appendix B). No public comments were received during the public outreach events.

3.4 PUBLIC AND STAKEHOLDER PARTICIPATION

Throughout the development of the original 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 website maintained by Berks County DES (http://www.berksdes.com). The process of public outreach began in September 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; floodplain 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 Mitigation Steering Committee. The Mitigation Steering Committee was reconvened as part of the Hazard Mitigation Plan Update. The members of the Hazard Mitigation Plan Update Mitigation Steering Committee are listed in Table 3-1.

TABLE 3-1
HAZARD MITIGATION PLAN UPDATE
MITIGATION STEERING COMMITTEE MEMBERS

MUNICIPALITY/ORGANIZATION	NAME
Berks County DES	Donnie Swope, Phillip Spence, Megan Young-Kraft, Phil Salamone, and Matthew Stairiker
City of Reading EMA	Kirk Litzenberger
Pennsylvania EMA	David Williams, Ernie Szabo, and Eric Rickenbach
Earl Township EMA	Sal Dippa
Kutztown University	John Dillon
Berks County Planning Commission	Matt McGough, David Hunter, and Ashley Showers
West Side Regional Emergency Management Agency (WSREMA)	Thomas Bausher, Michael Fesh, and David Adams
Berks County GIS	Brad Shirey
Alvernia University	Doug Smith
Berks County Intermediate Unit (BCIU)	Russel Del Rosario
Red Cross	Danielle Henkel

MUNICIPALITY/ORGANIZATION	NAME
Chester County EMA	Carrie A. Bamper and Kelly Tinsman
Albright University	Paul Janssen and Mike Gross
East Penn Manufacturing Co.	Troy Greiss
Berks County Conservation District	Kent Hiemlright and Dean Druckenmiller
Borough of Hamburg	Amy Burkhart
Muhlenberg Township	Dennis Walton
Penn State Health	Gine Bradley
Borough of Laureldale EMC	Josh Levengood
Salvation Army	Luke Rodgers
Berks County COAD, Centro Hispano	Rick Olmos
Berks County Parks and Recreation	Brendan Lederer and Cathy Wegener
Lancaster County EMA	Dan Sully and Christopher Christensen
Exeter Township EMC	David Bentz
St. Lawrence Borough EMC	David Eggert
Lower Alsace Township EMC	Don Pottiger
Berks County Industrial Development	Jeremy Zaborowski
Lower and South Heidelberg EMC	Justin Schlottman
Lower Heidelberg Township	Pamela Stevens and Cheryl Johnson
Berks Alliance	David Myers
PA American Water	Kristi English
Lebanon County EMA	Jason Weikel
Berks County Facilities and Operations	Douglas Bodden and Rex Levengood
Berks County Department of Ag	Tami Hildebrand and Kimberly Fies
Western Berks Water Authority	Chip Bilger and Matthew Walborn
Reading Area Water Authority	Mike Reider
Bern Township EMC	Kevin Hinkle
Montgomery County EMA	Jon Lesher
Berks County Information Systems	Justin Loose
Greater Reading Chamber Alliance	Landon Bernheiser
Aqua PA	Amanda Obosnenko
Borough of Leesport EMC	David Reimer

The first Mitigation Steering Committee meeting (in June 2022) disseminated materials regarding the development of the plan in several formats. A total of five Mitigation Steering Committee meetings were held through December 2022. A project information sheet was developed by Berks County DES and was distributed via United States mail and e-mail to all 72 municipalities in Berks County (see Table 3-2). This brochure was also posted on the Berks County DES website (http://www.berksdes.com).

TABLE 3-2
2023 MULTI-JURISDICTIONAL PLANNING PARTICIPATION

MUNICIPALITY	NAME	TITLE	PLANNING PARTICIPATION[2]	ADOPTION DATE		
				ORIGINAL PLAN	UPDATE PLAN	
				2007	2013	2018
Albany Township	Chris Schuker	Township Supervisor	X	N/A	07/01/13	03/04/2019
Alsace Township	Hunter Martin	EMC	X	07/18/07	8/21/13	10/17/2018
Amity Township	Pam Kisch	Secretary/Treasurer	X	09/17/08	12/18/13	09/05/2018
Bally Borough	Bruce Hoffman	EMC	X	07/02/07	11/4/13	08/07/2018
Bechtelsville Borough	Bruce Hoffman	EMC	X	09/12/07	12/11/13	10/17/2018
Bern Township	Brian Potts	Township Supervisor	X	07/09/07	08/12/13	08/07/2018
Bernville Borough	Brenda Strunk	Secretary/Treasurer	X	03/04/08	05/07/13	08/07/2018
Bethel Township	Brian Blouch	EMC	X	07/24/07	09/16/13	12/17/2018
Birdsboro Borough	Kenneth Imes	EMC	X	04/07/08	05/13/13	12/03/2018
Boyertown Borough	John Rambo	EMC	X	06/04/07	11/4/13	11/05/2018
Brecknock Township	John Miller	EMC	X	06/05/07	06/04/13	11/14/2018
Caernarvon Township	Paul Whiteman	EMC	X	07/10/07	3/11/14	08/14/2018
Centerport Borough	Alan Cook	EMC	X	11/05/07	08/05/13	08/06/2018
Centre Township	Jarrod K. Emes	EMC	X	10/08/07	01/06/14	07/24/2018
City of Reading	Jeremy Searfoss	Fire Marshall/EMC	X	07/09/07	08/08/13	01/14/2019
Colebrookdale Township	Todd Gamler	President	X	01/08/08	4/7/14	09/17/2018
Cumru Township	Scott Brady	EMC	X	12/18/07	05/21/13	08/21/2018
District Township	Tim Adam	EMC	X	06/04/07	08/15/13	01/17/2019
Douglass Township	Robert Bainbridge	EMC	X	06/05/07	08/12/13	09/10/2018
Earl Township[1]	Sal DiPippa	EMC	X	03/12/07	05/13/13	06/12/2018
Exeter Township	Dave Bentz	EMC	X	08/27/07	08/26/13	09/10/2018
Fleetwood Borough	Megan Young	EMC	X	07/09/07	08/12/13	08/13/2018
Greenwich Township	Matthew Brett	EMC	X	N/A	5/5/14	11/05/2018
Hamburg Borough	Keith Brobst	EMC	X	06/11/07	05/28/13	09/24/2018
Heidelberg Township	Don Ebling	EMC	X	06/28/07	05/30/13	08/30/2018
Hereford Township	Ken Garlick	EMC	X	08/07/07	08/06/13	11/20/2018

TABLE 3-2
(CONTINUED)

MUNICIPALITY	NAME	TITLE	PLANNING PARTICIPATION [2]	ADOPTION DATE		
				ORIGINAL PLAN	UPDATE PLAN	
				2007	2013	2018
Jefferson Township	Lori Deck	SecretaryTreasurer	X	N/A	12/14/13	08/11/2018
Kenhorst Borough	Brian Cole	EMC	X	06/07/07	07/02/13	08/02/2018
Kutztown Borough	Joshua Young	EMC	X	06/22/07	05/23/13	11/20/2018
Laureldale Borough	Joshua Levengood	EMC	X	06/11/07	11/11/13	01/14/2019
Leesport Borough	David Reimer	EMC	X	07/18/07	09/18/13	08/15/2018
Lenhartsville Borough	Bill Lillington	Mayor	X	N/A	11/06/13	02/06/2019
Longswamp Township	Bradley Sechler	EMC	X	05/22/07	07/23/13	12/11/2018
Lower Alsace Township	Don Pottiger	Township Manager/EMC	X	06/27/07	10/23/13	08/09/2018
Lower Heidelberg Township	Cheryl Johnson	Chairwoman	X	05/21/07	05/20/13	10/30/2018
Lyons Borough	Randy Schlegel	EMC	X	N/A	12/02/13	02/04/2019
Maidencreek Township	Chris Kline	EMC	X	07/26/07	06/13/13	08/09/2018
Marion Township	John Sileski	EMC	X	09/27/07	06/05/13	08/30/2018
Maxatawny Township	Jerilyn Wehr	Secretary/Treasurer	X	05/24/07	06/05/13	02/13/2019
Mohnton Borough	Dave Szilli	EMC	X	08/13/08	11/13/13	11/14/2018
Mount Penn Borough	Troy Goodman	Borough Council President	X	06/12/07	08/13/13	08/14/2018
Muhlenberg Township	Larry Moyer	EMC	X	06/18/07	05/20/13	10/30/2018
New Morgan Borough	Margie Bishop	Borough Manager	X	03/11/08	3/11/14	11/13/2018
North Heidelberg Township	Jim Moyer	EMC	X	06/27/07	10/23/13	08/22/2018
Oley Township [1]	Todd Kegerise	EMC	X	06/21/07	06/10/13	11/12/2018
Ontelaunee Township	Kim Berger	Secretary/Treasurer	X	N/A	05/06/14	07/05/2018
Penn Township	Christy Flaherty	Secretary/Treasurer	X	06/25/07	05/20/13	07/30/2018
Perry Township	Jarrod Emes	EMC	X	06/05/07	1/14/14	10/09/2018
Pike Township	Bryan Hess	EMC	X	N/A	12/18/13	12/19/2018
Richmond Township	Sharon Harrison	Secretary	X	08/13/07	12/09/13	01/14/2019
Robeson Township	Galen Brown	EMC	X	09/18/08	05/22/13	10/16/2018
Robesonia Borough	Gloria Grim	Borough Manager	X	07/12/07	09/03/13	08/06/2018
Rockland Township	Derick Wartzenluft	EMC	X	06/12/07	11/12/13	07/10/2018
Ruscombmanor Township	Don Miller	Township Supervisor	X	07/05/07	06/06/13	09/06/2018
Shillington Borough	Bruce Squibb	EMC	X	12/31/07	09/12/13	08/16/2018
Shoemakersville Borough	Jarrod Emes	EMC	X	06/05/07	06/04/13	08/07/2018
Sinking Spring Borough	Michael Hart	Borough Manager	X	06/07/07	06/06/13	07/25/2018
South Heidelberg Township	Justin Schlottman	EMC	X	06/14/07	05/09/13	09/25/2018
Spring Township	John Groller	Township Manager/Director of Financial Services	X	05/29/07	05/13/13	08/13/2018
St. Lawrence Borough	Dave Eggert	EMC	X	09/13/07	05/09/13	10/15/2018
Tilden Township	Jarrod Emes	EMC	X	07/07/07	06/13/13	08/08/2018

TABLE 3-2
(CONTINUED)

MUNICIPALITY	NAME	TITLE	PLANNING PARTICIPATION [2]	ADOPTION DATE		
				ORIGINAL PLAN	UPDATE PLAN	
				2007	2013	2018
Topton Borough	Steve Kline	EMC	X	11/12/07	08/12/13	10/22/2018
Tulpehocken Township	Kathy Judy	Secretary/Treasurer	X	06/11/07	01/06/14	08/08/2018
Union Township	Donald Basile	Chairman	X	09/24/07	12/16/13	08/20/2018
Upper Bern Township	Beth Showalter	Secretary/Treasurer	X	07/11/07	10/09/13	08/02/2018
Upper Tulpehocken Township	Susan Ehrets	Township Manager	X	07/10/07	5/14/13	08/14/2018
Washington Township	Rich Sichler	Township Manager	X	07/26/07	06/27/13	10/25/2018
Wernersville Borough	Justin Schlottman	EMC	X	08/01/07	06/06/13	09/05/2018
West Reading Borough	Thomas Bausher	EMC	X	07/17/07	06/18/13	08/21/2018
Windsor Township	Jarrod Emes	EMC	X	08/08/07	06/12/13	02/13/2019
Womelsdorf Borough	Donald Ebling	EMC	X	07/03/07	11/06/13	01/15/2019
Wyomissing Borough	Michele Bare	Borough Manager	X	07/10/07	06/11/13	08/14/2018
Berks County [1]	Donnie Swope	Assistant Director for Emergency Manager	X	03/08/07	04/25/13	01/14/2019

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

Additionally, Table 3-3 below summarizes the municipal participation in the plan update process in 2022/2023.

TABLE 3-3
MUNICIPAL PARTICIPATION SUMMARY

MUNICIPALITY	MEETINGS								FORMS	
	BERKS DES HAZARD MITIGATION PLANNING TRAINING	BERKS COUNTY MS4 STEERING COMMITTEE MEETING	BERKS COUNTY SOURCE WATER PROTECTION MEETING	SCM #1	SCM #2	SCM #3	SCM #4	SCM #5	MUNICIPAL ACTION PLANS	NFIP WORKSHEETS
Albany Township									X	X
Alsace Township		X							X	X
Amity Township									X	X
Bally Borough									X	X

TABLE 3-3

MUNICIPAL PARTICIPATION SUMMARY

MUNICIPALITY	MEETINGS								FORMS	
	BERKS DES HAZARD MITIGATION PLANNING TRAINING	BERKS COUNTY MS4 STEERING COMMITTEE MEETING	BERKS COUNTY SOURCE WATER PROTECTION MEETING	SCM #1	SCM #2	SCM #3	SCM #4	SCM #5	MUNICIPAL ACTION PLANS	NFIP WORKSHEETS
Bechtelsville Borough									X	X
Bern Township	X	X			X			X	X	X
Bernville Borough									X	X
Bethel Township	X								X	X
Birdsboro Borough		X	X						X	X
Boyertown Borough	X								X	X
Brecknock Township									X	X
Caernarvon Township									X	X
Centerport Borough									X	X
Centre Township									X	X
City of Reading	X	X					X		X	X
Colebrookdale Township									X	X
Cumru Township	X	X							X	X
District Township	X								X	X
Douglass Township	X								X	X
Earl Township	X			X	X		X	X	X	X
Exeter Township	X					X		X	X	X
Fleetwood Borough									X	X
Greenwich Township									X	X
Hamburg Borough	X						X	X	X	X
Heidelberg Township									X	X
Hereford Township									X	X
Jefferson Township									X	X
Kenhorst Borough									X	X

TABLE 3-3

MUNICIPAL PARTICIPATION SUMMARY

MUNICIPALITY	MEETINGS								FORMS	
	BERKS DES HAZARD MITIGATION PLANNING TRAINING	BERKS COUNTY MS4 STEERING COMMITTEE MEETING	BERKS COUNTY SOURCE WATER PROTECTION MEETING	SCM #1	SCM #2	SCM #3	SCM #4	SCM #5	MUNICIPAL ACTION PLANS	NFIP WORKSHEETS
Kutztown Borough									X	X
Laureldale Borough	X			X	X		X	X	X	X
Leesport Borough				X				X	X	X
Lenhartsville Borough									X	X
Longswamp Township									X	X
Lower Alsace Township	X					X			X	X
Lower Heidelberg Township				X	X	X			X	X
Lyons Borough									X	X
Maidencreek Township	X								X	X
Marion Township									X	X
Maxatawny Township									X	X
Mohnton Borough									X	X
Mount Penn Borough									X	X
Muhlenberg Township		X							X	X
New Morgan Borough									X	X
North Heidelberg Township									X	X
Oley Township	X								X	X
Ontelaunee Township									X	X
Penn Township									X	X
Perry Township									X	X
Pike Township	X								X	X
Richmond Township									X	X
Robeson Township									X	X
Robesonia Borough									X	X

TABLE 3-3

MUNICIPAL PARTICIPATION SUMMARY

MUNICIPALITY	MEETINGS								FORMS	
	BERKS DES HAZARD MITIGATION PLANNING TRAINING	BERKS COUNTY MS4 STEERING COMMITTEE MEETING	BERKS COUNTY SOURCE WATER PROTECTION MEETING	SCM #1	SCM #2	SCM #3	SCM #4	SCM #5	MUNICIPAL ACTION PLANS	NFIP WORKSHEETS
Rockland Township									X	X
Ruscombmanor Township									X	X
Shillington Borough									X	X
Shoemakersville Borough									X	X
Sinking Spring Borough	X	X		X	X	X	X	X	X	X
South Heidelberg Township				X	X	X			X	X
Spring Township	X			X	X	X	X	X	X	X
St. Lawrence Borough						X			X	X
Tilden Township									X	X
Topton Borough									X	X
Tulpehocken Township									X	X
Union Township	X								X	X
Upper Bern Township									X	X
Upper Tulpehocken Township									X	X
Washington Township									X	X
Wernersville Borough									X	X
West Reading Borough	X			X	X	X	X	X	X	X
Windsor Township									X	X
Womelsdorf Borough									X	X
Wyomissing Borough	X			X	X	X	X	X	X	X

*SCM – Steering Committee Meeting

3.5 MULTI-JURISDICTIONAL PLANNING

A number of organizations and individuals (including Berks County DES, Berks County Planning Commission [BCPC], Berks County Conservation District [BCCD], PEMA, FEMA, Pennsylvania Department of Conservation and Natural Resources [PA DCNR], Pennsylvania Department of Community and Economic Development [PA DCED], and National Weather Service [NWS]) provided support through the development of the plan. 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 Hazard Vulnerability Assessment and Mitigation Plan Update was developed in support of and using information from a number of other plans, studies, and technical reports specific to Berks County and Pennsylvania in general. These documents include Pennsylvania's All-Hazard Mitigation Planning Standard Operating Guide, Commonwealth of Pennsylvania's Multi-Hazard Identification and Risk Assessment, Berks County's recently issued (July 2012) Flood Insurance Study (FIS) and updated Flood Insurance Rate Mapping (FIRM), Berks County Comprehensive Plan 2030 Update, Berks County Hazard Vulnerability Analysis, Berks County Source Water protection plan/program, and neighboring county hazard mitigation plans. Appendix J contains a more complete listing of the technical references that were used to assist in the development of this Plan Update.

At the outset of the planning study, the Commonwealth of Pennsylvania's Multi-Hazard Identification and Risk Assessment was used to initially identify those natural hazards that were previously reported as having affected Berks County as well as those natural hazards which were considered to have mitigation potential within the County. This information was used to help develop Table 4-1 (Berks County Disaster History) and Table 4-2 (Berks County Hazard Identification Summary) of the Plan Update. Once the initial hazard identification was completed, more detailed hazard event profiling specific to Berks County (as outlined in Chapter 4) was developed using information from the Berks County Hazard Vulnerability Analysis and Berks County's recently issued FIS and updated FIRM.

In developing the multi-jurisdictional hazard mitigation strategy (i.e., Chapter 6), the Mitigation Steering Committee reviewed and considered the Berks County Comprehensive Plan 2030 Update. Specifically, the five-county planning regions outlined in the Comprehensive Plan were carried forward in this Hazard Mitigation Plan for consistency purposes. Additionally, much of Chapters 1, 2, and 3 of the Comprehensive Plan provided the background Information (i.e., location and setting, physical geography, geology, and environmental/natural features) used to

support the hazard event profiling in Chapter 4 of this Hazard Mitigation Plan. Further, a number of the Preventive Measure (PM) and Natural Resource (NR) Protection hazard mitigation measures outlined in Chapter 6 of this Hazard Mitigation Plan were developed in support of and to be consistent with the goals and policies in Chapter 7, Land Use of the Comprehensive plan. As such, this Hazard Mitigation Plan incorporates – not merely by reference, but by direct application – the County Comprehensive Plan.

Finally, the Mitigation Steering Committee reviewed the Schuylkill County Hazard Mitigation Plan (2019) to identify potential hazards in Schuylkill County that could have an impact on Berks County. The Mitigation Steering Committee chose to review the Schuylkill County Plan because the largest watercourse in Berks County, the Schuylkill River, flows from Schuylkill County into Berks County just north of Hamburg. While the Schuylkill County Plan clearly identified flooding from the Schuylkill River as one of its primary natural hazards of concern, the presence of two high-hazard dams in the Little Schuylkill River Watershed was also of notable interest. These dams include the 98-foot-high Locust Creek Dam in Tuscarora State Park in Rush Township and the 86-foot-high Still Creek Dam in Rush Township. Both of these reservoirs drain into the Little Schuylkill River near Hometown, Pennsylvania, and have been rated by the Pennsylvania Department of Environmental Protection (PA DEP) as having the potential for substantial loss of life and excessive economic impacts in the event of a catastrophic failure. Fortunately, these high-hazard dams are located approximately 20 miles north of Hamburg, allowing for advance warning opportunities in the event of failure. Much like the recommendations for the dams in Berks County, Schuylkill County identified ongoing maintenance and routine inspections as the primary means for ensuring that a catastrophic dam failure never occurs.

4.0 RISK ASSESSMENT

4.1 UPDATE PROCESS SUMMARY

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 Mitigation 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 levels specific to Berks County (see Table 4-1);
- analysis of hazard identification and risk assessment publications at the state and local levels;
- limited field reconnaissance; and
- Internet research.

TABLE 4-1
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
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

TABLE 4-1
(CONTINUED)

DATE	HAZARD EVENT	ACTION
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 and 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
September 2005	Proclamation of Emergency (Hurricane Katrina)	Governor's Proclamation
June 2006	Flooding	Governor's Proclamation and President's Declaration of Major Disasters
September 2006	Tropical Depression (Ernesto)	Governor's Proclamation
February 2007	Severe Winter Storm	Governor's Proclamation of Disaster Emergency
April 2007	Severe Storm	Governor's Proclamation
November 2007	Fire	SBA – Physical Damage and Economic Injury
August 2008	Fire	SBA – Physical Damage and Economic Injury
September 2008	Fire	SBA – Physical Damage and Economic Injury
January 2009	Fire	SBA – Physical Damage and Economic Injury
August 2009	Storms and Flooding	SBA – Physical Damage and Economic Injury
February 2010	Severe Winter Storms	Governor's Proclamation
March 2010	Severe Winter Storms	Governor's Proclamation
January 2011	Severe Winter Storms	Governor's Proclamation
March 2011	Severe Winter Storms	Governor's Proclamation
August 2011	Hurricane Irene	Governor's Proclamation
September 2011	Tropical Storm (Lee)	President's Declaration of Emergency Disasters and Declaration of Major Disasters
October 2012	Hurricane Sandy	Governor's Proclamation and President's Declaration of Emergency Disasters
June 2013	Severe Storms, Flooding, Tornadoes	Major Disaster Declaration
February 2014	Severe Winter Storms	Governor's Proclamation, Major Disaster Declaration, Emergency Declaration

TABLE 4-1
(CONTINUED)

DATE	HAZARD EVENT	ACTION
January 2015	Severe Winter Storms	Governor's Proclamation
June 2015	Severe Storms	Governor's Proclamation
January 2016	Severe Winter Storms	Governor's Proclamation and Major Disaster Declaration
March 2017	Severe Winter Storms	Governor's Proclamation
June 2018	Severe Weather Event	Governor's Proclamation
July 2018	Flooding	SBA
August 2018	Severe Storms and Flooding	Governor's Proclamation and Major Disaster Declaration
January 2019	Severe Winter Event	Governor's Proclamation
June 2019	Flash Flooding	SBA
July 2019	Flash Flooding	SBA
March 2020	COVID-19 Pandemic	Governor's Proclamation, Major Disaster Declaration, Emergency Declaration
July 2020	Fire	SBA
August 2020	Tropical Storm Isais	SBA
December 2020	Winter Weather	Governor's Proclamation
February 2021	Winter Weather	Governor's Proclamation
August 2021	Remnants of Hurricane Ida	Governor's Proclamation and Major Disaster Declaration

Source: PEMA and FEMA

In addition, Berks County's 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.

4.2 HAZARD IDENTIFICATION

Table 4-2 summarizes the identification of the hazards that present the greatest risk to the County. The known natural hazards to be addressed in this plan include:

- dam failure,
- drought,
- flooding,
- hurricanes,
- land subsidence,
- landslides,
- earthquakes,

- severe storms,
- tornadoes,
- wildfires,
- radon,
- technological hazards, and
- pandemics.

TABLE 4-2
BERKS COUNTY HAZARD IDENTIFICATION SUMMARY

	HAZARD DESCRIPTION	HOW IDENTIFIED	WHY IDENTIFIED
 Dam Failure	Dam failure is the uncontrolled release of water (and any associated wastes) from a dam. This hazard often results from a combination of natural and human causes, and can follow other hazards such as hurricanes, earthquakes, and landslides. The consequences of dam failures can include property and environmental damage and loss of life.	• Input from PA DEP, Division of Dam Safety • United States Geological Survey (USGS)	• 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
 Drought	Drought is defined as a deficiency of precipitation experienced over an extended period of time, usually a season or more. Droughts increase the risk of other hazards, like wildfires, flash floods, and landslides or debris flow. This hazard is of particular concern in Pennsylvania due to the prevalence of farms and other water-dependent industries, water-dependent recreation uses, and residents who depend on wells for drinking water.	• Review of past disaster declarations • Analysis of the County's Vulnerability Assessment • Input from PA DEP	• Severity and frequency of past events • Numerous County residents and agricultural operations dependent on constant water sources
 Floods	Flooding is a temporary condition of partial or complete inundation of normally dry land, and it is the most frequent and costly of all natural hazards in Pennsylvania. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often along mountain streams and in urban areas where much of the ground is covered by impervious surfaces. Winter flooding can include ice jams which occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rains can cause frozen rivers to swell, which breaks the ice layer on top of the river. The ice layer often breaks into large chunks, which float downstream, piling up in narrow passages and near other obstructions such as bridges and dams.	• Review of past disaster declarations • Review FIRM • Identification of National Flood Insurance Program (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	Hurricanes, tropical storms, and nor'easters are classified as cyclones and are any closed circulation developing around a low-pressure center in which the winds rotate counterclockwise (in the Northern Hemisphere) and whose diameter averages 10-30 miles across. Potential threats from hurricanes include powerful winds, heavy rainfall, storm surges, coastal and inland flooding, rip currents, tornadoes, and landslides. The Atlantic hurricane season runs from June 1 to November 30.	• Review of past disaster declarations • Analysis of the County's Vulnerability Assessment • Input from the National Oceanic and Atmospheric Administration (NOAA)	• Severity of the flood-related damages caused by the 1972 (Agnes), 1975 (Eloise), 1999 (Floyd), 2001 (Allison), and 2012 (Sandy) events

TABLE 4-2
(CONTINUED)

	HAZARD DESCRIPTION	HOW IDENTIFIED	WHY IDENTIFIED
 Subsidence	Land subsidence is a gradual settling or sudden sinking of the ground surface due to the movement of subsurface materials. A sinkhole is a subsidence feature resulting from the sinking of surficial material into a pre-existing subsurface void. Subsidence and sinkholes are geologic hazards that can impact roadways and buildings and disrupt utility services. Subsidence and sinkholes are most common in areas underlain by limestone and can be exacerbated by human activities such as water, natural gas, and oil extraction.	• Input from the Pennsylvania Geological Survey • Analysis of geologic mapping	• Presence of carbonate rock units • Known sinkhole locations within the County
 Landslides	In a landslide, masses of rock, earth or debris move down slope. Landslides can be caused by a variety of factors, including earthquakes, storms, fire, and human modification of land. Areas that are prone to landslide hazards include previous landslide areas, areas on or at the base of slopes, areas in or at the base of drainage hollows, developed hillsides with leach field septic systems, and areas recently burned by forest or brush fires.	• Input from the Pennsylvania Geological Survey • Input from the Pennsylvania Department of Transportation (PennDOT)	• Mountainous topography within the County
 Earthquake	An earthquake is the motion or trembling of the ground produced by sudden displacement of rock usually within the upper 10-20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns. Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of persons, and disrupt the social and economic functioning of the affected area.	• Input from the Pennsylvania Geological Survey	• Severity and frequency of past events
 Hailstorms/Winter Storm	Hailstorms occur when ice crystals form within a low-pressure front due to the rapid rise of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight, they fall as precipitation in the form of balls or irregularly shaped masses of ice greater than 0.75 inches in diameter. Hailstorms can cause significant damage to homes, vehicles, livestock, and people. A winter storm is a storm in which the main types of precipitation are snow, sleet, or freezing rain. A winter storm can range from a moderate snowfall or ice event over a period of a few hours to blizzard conditions with wind-driven snow that lasts for several days. Most deaths from winter storms are not directly related to the storm itself, but result from traffic accidents on icy roads, medical emergencies while shoveling snow, or hypothermia from prolonged exposure to cold.	• Review of past disaster declarations • Input from NOAA • Local knowledge/public input	• Severity and frequency of past events • Identified as a significant threat Countywide
 Tornado/Wind	A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. About 1,250 tornadoes hit the U.S. each year, with about 16 hitting Pennsylvania. Damaging winds exceeding 50-60 miles per hour can occur during tornadoes, severe thunderstorms, winter storms, or coastal storms. These winds can have severe impacts on buildings, pulling off the roof covering, roof deck, or wall siding and pushing or pulling off the windows.	• Analysis of the County's Vulnerability Assessment • Review of past disaster declarations • Input from NOAA	• Severity and frequency of past events

TABLE 4-2
(CONTINUED)

	HAZARD DESCRIPTION	HOW IDENTIFIED	WHY IDENTIFIED
 Wildfire	A wildfire is an unplanned fire that burns in a natural area. Wildfires can cause injuries or death and can ruin homes in their path. Wildfires can be caused by humans or lightning, and can happen anytime, though the risk increases in period of little rain. In Pennsylvania, 98% of wildfires are caused by people.	• Analysis of the County's Vulnerability Assessment • Input from PA DCNR	• Frequency of past events • Presence of forested tracts within the County
 Radon Exposure	Radon is a radioactive gas produced by the breakdown of uranium in soil and rock that can lead to lung cancer in people exposed over a long period of time. Most exposure comes from breathing in radon gas that enters homes and buildings through foundation cracks and other openings. According to the DEP, approximately 40% of Pennsylvania homes have elevated radon levels.	• Input from PA DEP Bureau of Radiation Protection, Radon Design • Review of United States Environmental Protection Agency (U.S. EPA) radon guidelines	• Presence in soil, rock, and water • Known elevated levels in Pennsylvania
 Cyber-Terrorism	Cyber terrorism refers to acts of terrorism committed using computers, networks, and the internet. The most widely cited definition comes from Denning's Testimony before the Special Oversight Panel on Terrorism: "Cyberterrorism…is generally understood to mean unlawful attacks and threats of attack against computers, networks, and the information stored therein when done to intimidate or coerce a government or its people in furtherance of political or social objectives. Further, to qualify as cyberterrorism, an attack should result in violence against persons or property, or at least cause enough harm to generate fear.	• Input from steering committee	• As technology advances, cyber security gets more difficult
 Pandemic/Infectious Disease	A pandemic is a global outbreak of disease that occurs when a new virus emerges in the human population, spreading easily in a sustained manner, and causing serious illness. An epidemic describes a smaller-scale infectious outbreak, within a region or population, that emerges at a disproportional rate. Infectious disease outbreaks may be widely dispersed geographically, impact large numbers of the population, and could arrive in waves lasting several months at a time.	• COVID-19 Pandemic occurring during the 2023 update	• Significant hazard county wide

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.

4.3 HAZARD EVENT PROFILES

4.3.1 Dam Failure

- 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

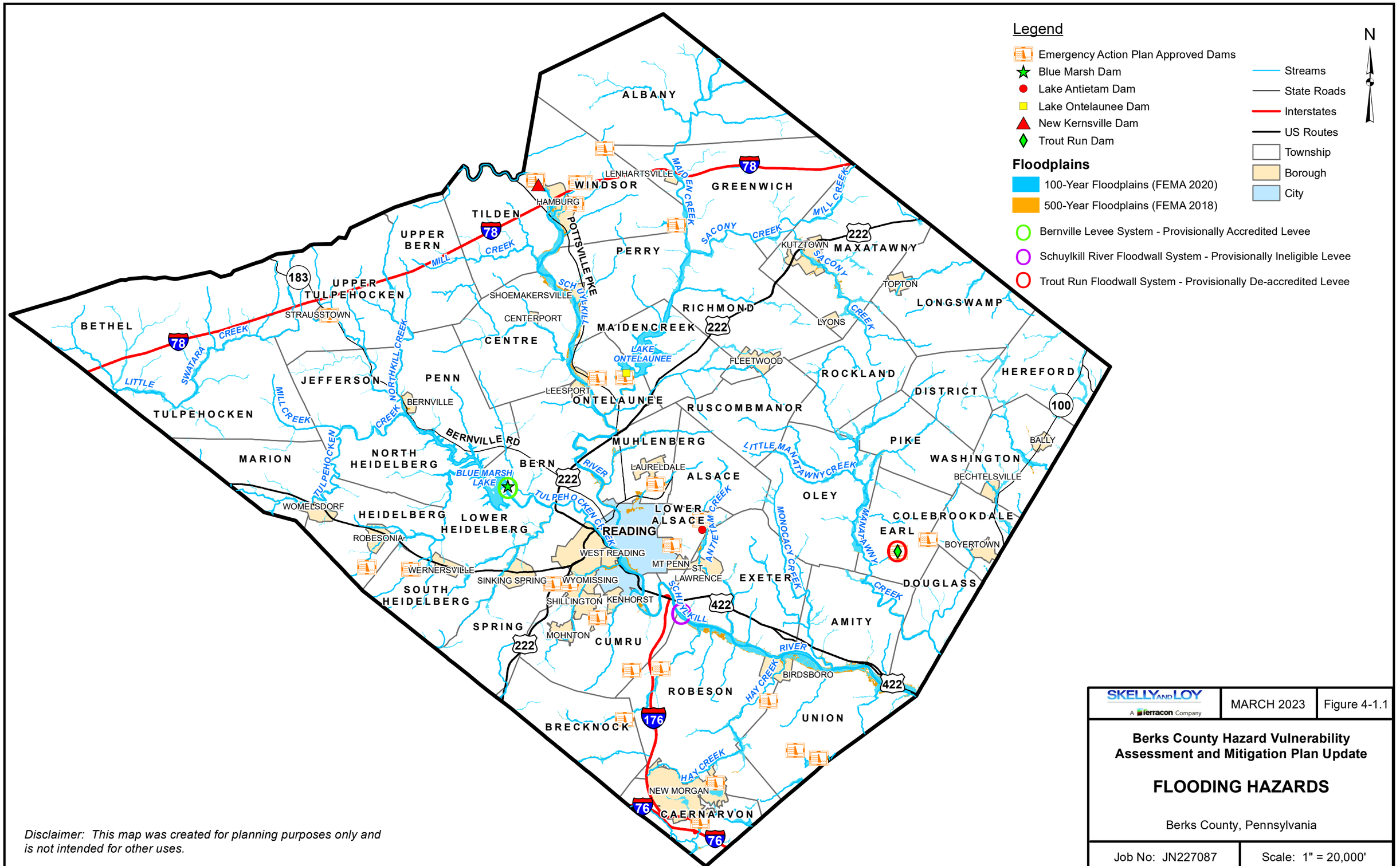
Proper design, regular maintenance, and routine inspection can go a long way in preventing a dam failure.

4.3.1.1 Location and Extent – 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. Five 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 one mile northwest of the Borough of Hamburg, Lake Antietam Dam on Antietam Creek in Lower Alsace Township (see Figure 4-1.1), and Trout Run Dam on Trout Run located west of Boyertown. 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.

Blue Marsh Dam was constructed in the mid-1970s for the purpose of flood control. The dam is owned and operated by the United States 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 the worst-case scenario being spillway design flood with dam failure producing a peak flow of 493,000 cfs. The Blue Marsh Dam Safety Plan was finalized in March 2014. 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 and 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 two 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.



Disclaimer: This map was created for planning purposes only and is not intended for other uses.

SKELLY AND LOY A terracon Company	MARCH 2023	Figure 4-1.1

Berks County Hazard Vulnerability Assessment and Mitigation Plan Update

FLOODING HAZARDS

Berks County, Pennsylvania

Job No: JN227087	Scale: 1" = 20,000'

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 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; revised May 2012), 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 PMF event as the maximum magnitude dam failure hazard to be studied in the plan for the Ontelaunee Dam. As part of the 2023 update, Bill Murray from the Reading Area Water Authority was interviewed November 9, 2022. Mr. Murray confirmed that the Ontelaunee Dam is scheduled for replacement. There is funding in place; however, the Pennsylvania Department of Environmental Protection has not been able to review the permit and provide approval. Upon authorization of the permit, the Ontelaunee Dam will be replaced.

Kernsville Dam is owned by PA DEP, is operated along with the Rausch 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. In April 2017, PA DEP proposed removing the dam, dependent on state funding. As of October 2022, the dam has yet to be removed but is still proposed to be removed by PA DEP.

Lake Antietam Dam is owned by Berks County, but it is no longer 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.

The normal pool elevation is 264 acre-feet with the 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. The 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.

Trout Run Dam is owned by Boyertown Borough and is operated by Severn Trent Environmental Services. Trout Run Dam is a 105-foot-high, 460-foot-long earthen embankment dam and contains 1,169 acre-feet of water with a maximum capacity of 1,652 acre-feet. The inundation area resulting from a sudden dam failure includes portions of Earl, Amity, and Douglass Townships in Berks County and West Pottsgrove Township and the Borough of Pottstown in Montgomery County. The immediate inundation area encompasses 150 to 175 homes, with an estimated total population of 500 people. 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 Trout Run Dam.

Anthonys Mill Dam is owned and operated by John Delong. Anthonys Mill Dam is a 15-foot high, 110-foot-long concrete embankment dam, maintaining a normal pool of 10.6 acre-feet of water with a maximum pool capacity of 12 acre-feet. The dam is located across Jackson Creek, approximately 0.5 miles south of Strausstown and approximately 450 feet west of State Route 183, just north of Mill Road. The inundation area resulting from a sudden dam failure is limited to the embankment areas of a short section of Jackson Creek and Little Northkill Creek junction to the Spring Road culvert with some potential minor flooding of the Mill Road Bridge and the Route 183 culvert. There is no population within the inundation area. The mill building itself, currently unoccupied and in use for storage, is within the inundation area directly downstream of the dam. There are no other structures 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 Anthonys Mill Dam.

Bernhart Dam is owned by the City of Reading and operated by City of Reading Public Works. The dam is a 30-foot high, 180-foot-long earthen embankment recreation dam, maintaining a normal pool of 128.7 acre-feet of water with a maximum pool capacity of approximately 150 acre-feet. The dam is located across Bernhart Creek, 4 miles north of the City of Reading, one mile east of State Route 222, and ½-mile north of State Route 12. The inundation area resulting from a sudden dam failure is bordered on the north by Spring Valley Road to its

intersection with State Route 12, from which point is bordered by State Route 61. On the southeast, the inundation area is bordered by N. 12th Street to its intersection with State Route 12, from which point is bordered by Pennsylvania Lines, LLC railroad tracks. The inundation map was developed with the conservative assumption that the storm sewer system which currently carries Bernhart Creek underground to Schuylkill River would handle a negligible amount of water. The inundation area includes portions of the City of Reading and low-lying areas along Bernhart Creek within Muhlenberg Township located north of Reading. Within the inundation area are approximately 625 residents, 235 homes, and 12 businesses. Bernhart Dam was drawn down in 2022 and the center of the spillway was removed to the rock ledge upon which it was built to ensure structural stability and allow the normal flow of the creek to run naturally through the dam without being impeded. 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 Bernhart Dam.

Boyertown Reservoir (Popodickon) Dam is owned by Boyertown Bourgh and Operated by Severn Trent Environmental Services. The Boyertown Reservoir (Popodickon) Dam is 55 feet high, 620-foot-long earthen embankment dam, maintaining a normal pool of 105 acre-feet of water with a maximum capacity of 156 acre-feet. The dam is located along an Unnamed Tributary of Ironstone Creek approximately 1.6 river miles upstream of the confluence of the Unnamed Tributary with Ironstone Creek. From the intersection of State Route 73 and Funk Road the dam is located approximately 1.7 miles west. The inundation area resulting from a sudden dam failure includes portions of Earl, Colebrookdale, and Douglas Township and Boyertown Borough. The inundation area includes the valley floor of the Unnamed Tributary to the Ironstone Creek from the dam to the Community of Gabelsville and the valley floor along Ironstone Creek from Gabelsvillee to the Maxatawny Creek. Within the inundation area is a population of approximately 175 people. 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 Boyertown Reservoir.

Christman Dam is owned and operated by Dennis C. Christman. The dam is a 27-foot high, 630-foot-long earthen embankment recreation dam, maintaining a normal pool of 234 acre-feet of water with a maximum pool capacity of 322 acre-feet. The dam is located one mile north of Virginville, ¼ mile west of State Route 143. The dam is located on an Unnamed Tributary of Maiden Creek. The inundation area resulting from sudden dam failure is bordered from the dam to Virginville generally on the west by Route 143 and the east by the north/south running railroad tracks. The area from Virginville to Lake Ontelaunee includes the low-lying areas

along the Maiden Creek. Within the inundation area are approximately 22 homes. 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 Christman Dam.

Engelman Dam is owned by the City of Reading and operated by the City of Reading Public Works. The dam is a 10-foot high, 700-foot-long earthen embankment recreational dam, maintaining a normal pool of 17 acre-feet of water with a maximum pool capacity of 21 acre-feet. The reservoir is used by Izaak Walton League as a fish nursery. The dam is located to the north of Hill Road near its intersection with Glen Road, with in the City of Reading approximately 0.8 miles north of State Route 422 Business (Mineral Spring Road). The inundation area resulting from a sudden dam failure is bordered on both sides of the downstream creek that runs from the dam by a natural earthen embankment running parallel to Glen Road (north-south direction). At the point where the creek enters underground storm sewer system, flood waters will flow overland across Pendora Park and follow Muhlenberg Street to the Schuylkill River. The inundation area is located entirely within the City of Reading. Within the inundation area, which follows a city street for nine blocks, are approximately 200 homes, one school, one day care center, approximately 15 business and a population of approximately 900 residents (conservative estimate). According to Census data, the average household and family within this region are 2.59 and 3.08 respectively. 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 Engelman Dam.

Grace Mine Tailings Dam is owned and operated by Southern Berks Land Company, LP. The dam is a 2,000-foot long, 145-foot-high earth and rock fill dam with a crest at elevation 615 feet. The lake pool volume is 2,890 acre-feet at elevation 611 feet while the maximum pool volume at the dam crest is 3,612 acre-feet. Prior to 2019, the pool level in the reservoir was controlled by a concrete riser that discharged through a pipe through the dam embankment to an outlet at the toe of the dam. That pipeline was grouted closed in 2019 and a new inlet and pipeline was installed along the left abutment of the dam, and this new inlet currently controls the normal pool level at elevation 600 feet, the reservoir is 50% water and 50% immobile tailings solids, while all storage above this elevation is 100% water. The dam is located in the Borough of New Morgan, on an Unnamed Tributary of the Hay Creek, approximately 2.4 miles northeast of the Morgantown Interchange of the PA Turnpike. The inundation area resulting from a sudden dam failure follows an Unnamed Tributary to Hay Creek through the Borough of New Morgan, Robeson Township, and a smaller corner of Union Township near Geigertown, enroute to the confluence of Hay Creek with the Schuylkill River in Birdsboro, which is approximately 8

miles downstream of the dam. Within the inundation area are approximately 138 residents, 3 churches, 10 businesses, a sewage treatment plant, and a new gas fired power plant. It is estimated that a total of 600 people could be present within these structures in the event of a dam failure. These figures were estimated from 2008 Aerial Photography from the Pennsylvania Spatial Data Access website, US Census Data, a site reconnaissance, and worst-case assumptions regarding the number of people in each structure. 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 Grace Mine Tailings Dam.

Green Hills Lake Dam is owned and operated by Green Hills Lake Recreation Association. The dam is an 18-foot high, 525-foot-long structure and features a concrete spillway and earthen embankment. The height of the concrete spillway varies between 10-feet and 18-feet and is 160-feet long. It maintains a normal pool of 104 acre-feet of water with a maximum pool capacity of 252 acre-feet. The dam is located along the Allegheny Creek, 6 miles north of Morgantown and 4 miles south of the City of Reading, off Route 568, ½ miles east of Route 10. The inundation area resulting from a sudden dam failure is the valley floor along the Allegheny Creek following Route 568 east for 3.5 miles to Gibraltar. Within the inundation area are 3 homes with approximately 6 total 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 Green Hills Dam.

Hamburg Flood Control Dam PA-476 and PA-477 are both owned and operated by the Borough of Hamburg, while operations of both dams fall under the Borough of Hamburg Publics Works Superintendent. The Hamburg Flood Control Dam PA-476 is 46 feet high, 400-foot-long earthen embankment dam, maintaining a normal pool of 6 acre-feet of water with a maximum capacity of 102 acre-feet. The dam is located along a tributary to Mill Creek, approximately 0.66 miles east of the northeastern most corner of the Borough of Hmaburg boundary line and approximately 1,000 feet north of Interstate I-78. The inundation area resulting from a sudden dam failure includes the low-lying areas of Mill Creek and low-lying areas of the Borough of Hamburg such as Primrose Alley, South 4th Street, Apple Alley, North and South 3rd Street, South 2nd Street, Grand Street, Walnut Street, Pine Street, Washington Street, South Front Street, State Street, Island Street, Plum Alley, and Peach Alley. Within the inundation area approximately 160 homes and 25 commercial and industrial businesses with an estimated total population of 500 people. 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 Hamburg Flood Control Dam PA-476.

The Hamburg Flood Control Dam PA-477 is a 52-feet high, 1,550-foot-long earthen embankment dam, maintaining a normal pool of 11 acre-feet of water with a maximum capacity of 371 acre-feet. The dam is located along a tributary to Mill Creek, approximately 1 mile east of the norther most corner of the Borough of Hamburg boundary line and approximately 800 feet north of Interstate I-78. The inundation area resulting from a sudden dam failure includes the low-lying areas of Mill Creek and low-lying areas of the Borough of Hamburg such as Primrose Alley, South 4th Street, Apple Alley, North and South 3rd Street, South 2nd Street, Grand Street, Walnut Street, Pine Street, Washington Street, South Front Street, State Street, Island Street, Plum Alley, and Peach Alley. Within the immediate inundation area are approximately 155 homes and 25 commercial and industrial businesses with an estimated total population of 600 people. 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 Hamburg Flood Control Dam PA-477.

Hamburg Reservoir Dam is owned and operated by the Hamburg Municipal Authority. The Hamburg Reservoir Dam is a 53-foot high, 500-foot-long earthen embankment dam, maintaining a normal pool of 92 acre-feet of water with a maximum capacity of 145 acre-feet. The dam is located along Furnace Creek, approximately 1.67 miles east and 1.33 miles north from the eastern Bourgh of Hamburg boundary line along Old Route 22. The inundation area resulting from a sudden dam failure is a 300- to 500-foot-wide area along Furnace Creek and an Unnamed Tributary, 1200 feet east of Furnace Creek, extending from Hamburg Reservoir to Route 22/I-78. Within the immediate Inundation area are approximately 25 homes with an estimated population of 84 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 Hamburg Reservoir Dam.

Hopewell Dam is owned by The Pennsylvania Department of Conservation and Natural Resources, Bureau of State Parks, and operated by the Park Manager French Creek State Park. The dam is a 29-foot high, 1,000-foot-long zoned earthen embankment recreation dam, maintaining a normal pool of 569 acre-feet of water with a maximum pool capacity of 943 acre-feet. The dam is located across French Creek, approximately 3 miles north of intersection PA 23 and 345 in Warwick. The inundation area resulting from a sudden dam failure follows along the valley floor of the French Creek, extending downstream through the communities of St. Peters, Knauertown, and Coventryville to Route 100 south of Pughtown. Within the inundation area are 40 homes with an approximate total population of 120 people. 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 Hopewell Dam.

Indian Run Reservoir Dam is owned by the Birdsboro Water Authority and operated by the Manager of the Birdsboro Water Department. The dam is a 40-foot high, 430-foot-long earthen embankment recreation dam, maintaining a normal pool of 70 acre-feet of water with a maximum pool capacity of 92 acre-feet. The dam is located approximately 2 1/2 miles south of the Borough of Birdsboro in Robeson Township, east of Haycreek rd (former state route 82) on the head waters of Indian Run. The inundation area resulting from a sudden dam failure follows along the Haycreek. This area, mostly forest in area of the dam. Flowing northward flood waters would consume the entire rustic picnic area. Crossing Haycreek Rd into the texas ball field. Following the Haycreek toward downtown Birdsboro. Flood water reaching three residences at the dead end of Drew Court. Continuing downstream, Flooding reaching the South Mill Street to East First Street. Then flooding East First, to just short of Spruce Street. Flooding all North Water Street up to the east side of Cinder Street into the Main Bird Estates. East Main Street from Mill Street to the Hill approaching School Street. Flooding would finally continue making its way to enter the Schuylkill River. Within the inundation area is a population of approximately 350-400 people. There is approximately 115 Residential and 20 Commercial properties affected by this 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 Indian Run Reservoir Dam.

Kaercher Creek Lake Dam is owned and operated by the Pennsylvania Fish and Boat Commission. The dam is a 56-foot high, 680-foot-long earth-filled recreation dam, maintaining a normal pool of 464 acre-feet of water with a maximum pool capacity of 1,889 acre-feet. The dam is located on the Kaercher Creek in Windsor Township approximately ¼ mile northwest of the Borough of Hamburg on on St. John's Road. The inundation area resulting from a sudden dam failure follows the flood plain of the Kaercher Creek and includes portions of Windsor Township and the Borough of Hamburg. Within the inundation area are approximately 100 residents in 44 homes and residents in 7 apartments; as well as approximately 30 employees/customers in 6 small business. Larger inundation properties include Pine Street Apartments with 96 units and 220 residents, Hamburg Manufacturing with 50 employees and KMX International with 40 employees. 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 Kaercher Creek Lake Dam.

Lauer Run Detention Basin Dam is and operated by the Borough of Wyomissing. The

dam is a 9-feet high, 550-foot-long earthen construction, maintaining a normal pool of 0 acre-feet of water with a maximum pool capacity of 18 acre-feet. The dam is located at the 200 block of Logan Avenue near Cambridge Avenue. The inundation area resulting from a sudden dam failure is bordered on the north by Reading Blvd and on the south by Meadow Lane and Cambridge Ave and includes the area along the Wyomissing Creek into West Reading. There are zero homes within the Inundation Area. The land is mostly Borough-owned Park Land. 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 Lauer Run Detention Basin Dam.

Miller's Dam is owned and operated by Norman Miller. The dam is a 21-foot high, 240-foot-long earthen embankment recreation dam, maintaining a normal pool of 14 acre-feet of water with a maximum pool capacity of 34 acre-feet. The dam is located across a tributary to the Allegheny Creek, 350 feet south of the intersection of Hartz Store Road and Lakewood Drive in Brecknock Township. No urban centers or concentrated development areas are located immediately downstream of the dam along Allegheny Creek. The closest developed municipal center in Mohnton Borough, which is located approximately 4.5 miles to the north-northwest, and does not lie downgradient of the dam. The downstream area for approximately 3 miles consists primarily of rural and low-density residential and agricultural areas. The inundation area resulting from a sudden dam failure is bordered on the east by Westley Road and Hartz Store Road and Kurtz Mill Road. Within the inundation area is a population of approximately 22 to 25 people. Ten habitable structures are present downstream of the dam in the mapped 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 Miller's Dam.

Millwater Dam is owned and operated by the Southern Berks Land Company, LP. The dam is a 440-foot long, 26-foot-high earthen dam with an emergency spillway crest at elevation 570 feet. The normal pool capacity of the dam is 133 acre-feet at elevation 570 feet while the maximum pool capacity at the dam crest is 210 acre-feet. The dam is located in the Borough of New Morgan, Berks County on an unnamed tributary of the East Branch of the Conestoga River, approximately 0.4 miles north of the Morgantown Interchange of the PA Turnpike. The inundation area resulting from a sudden dam failure follows an unnamed tributary to the East Branch of the Conestoga River through the Borough of New Morgan and Caernarvon Township. Within the inundation area are approximately 2 residences with an estimated 8 residents, and 2 large businesses with an estimated 215 people during working hours. These figures were estimated from the 2008 Aerial Photography from the Pennsylvania Spatial Data Access website, discussions with representatives from the 2 businesses, and site reconnaissance. 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 Millwater Dam.

Scott's Run Dam is owned by the Department of Conservation and Natural Resources and operated by the French Creek State Park Manager. The dam is a 34-foot high, 625 feet long zoned earthen recreation Dam, maintaining a normal pool of 200 acre-feet of water with a maximum pool capacity of 425 acre-feet. The dam is located across Scott's Run in French Creek State Park. The dam is approximately 0.75 miles upstream of Hopewell Lake, 8.5 miles southwest of Pottstown and 1.6 miles west of the intersection of SR 345 and SR 4020 and 12 miles southeast of the City of Reading. The inundation area resulting from a sudden dam failure, which would cause potential flooding from the dam, along the valley floor of the French Creek, extending downstream through the communities of St. Peters, Knauertown, Coventryville to Route 100 south of Pughtown. Within the inundation area are approximately 150 residents and 40 homes. 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 Scott's Run Dam.

Shillington Memorial Park Dam is owned by the Borough of Shillington and operated by the Borough of Shillington Emergency Management Coordinator. The dam is a 9-foot high, 121-foot-long earthen embankment recreation dam, maintaining a normal pool of 7 acre-feet of water with a maximum pool capacity of 7.8 acre-feet. The dam is located along an Unnamed Tributary to Angelica Creek within the Borough of Shillington, approximately 1,000 feet south of Philadelphia Avenue (S.R. 724) and 3,000 feet west of New Holland Road (S.R. 625). The inundation area resulting from a sudden dam failure is bordered on the west by Ridge Park Subdivision an on the east by Governor Mifflin School District property and includes low-lying portions of parks and recreation area which is owned and maintained by the Borough of Shillington. Within the inundation area are no residents, no homes and/or places of business. 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 Shillington Memorial Park Dam.

Stanford Avenue Detention Basin Dam is owned and operated by the Township of Spring. The dam is a 27-foot high, 480-foot-long earthen embankment detention dam, maintaining a normal pool of 0 acre-feet of water with a maximum capacity pool of 135 acre-feet. The dam is located between S.R. 724 and S.R. 222 bypass, approximately 1,000 feet north of the S.R.724/S.R.222 interchange. The inundation area resulting from a sudden dam failure fall within the border of Penn Avenue to the north and Museum Road to the south and includes portions of Spring Township, West Reading Borough, Wyomissing Borough, and the City of Reading. Within the inundation area are approximately 600 residences, 10 businesses, the

Reading Museum, and a sewage disposal facility, and two playgrounds. 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 Stanford Avenue Detention Basin Dam.

Not all dams listed in Table 4.3.1-1 are high hazard dams, and are not required to maintain an Emergency Action Plan (EAP) as per DEP. There are five dams with limited analysis to provide risks and vulnerabilities associated. The five dams are Ashley Furniture, Maiden Creek Reservoir, Palmer, Rock Hollow Road and Stinson Run dams.

Berks County Department of Emergency Services will continue to work with Dam owners/operators responsible in maintaining five-year dam plans and the engineering firms contracted to write EAPs and provide inundation mapping. Also, in coordination with DEP, review, and comment on dam plan submissions to the county and state, and assist in concurrence signatures from municipal officials, NGOs, PEMA, and DEP. All dam plans are available at Berks County Department of Emergency Services the public to view by appointment.

Berks County is also downstream of several dams in neighboring Schuylkill County that during a flooding event potential would have cascading effects on Berks County tributaries and potentially lead to increased flooding if one or more dam failures were to occur. Dams in Schuylkill County of potential risk are Indian Run, Leaser Lake, Locust Creek Dam and Locust Lake Dam.

Indian Run is owned and operated by the Schuylkill County Municipal Authority. The dam is a 94-foot high, 700-foot long rolled earthen embankment with concrete core wall, maintaining a normal pool of 1,498 acre-feet of water with a maximum pool capacity of 1,943 acre-feet. The dam is located approximately 2,00 feet from the confluence of Indian Run and the west branch of the Schuylkill River, about 1,700 feet above the Lehigh Valley Railroad. The dam is located off S.R. 0901, near Pottsville, in Branch Township, Schuylkill County. The inundation area resulting from a sudden dam failure will vary in width from approximately 200 feet to 500 feet. The Borough of Cressona, Schuylkill Haven, Landingville, Auburn, Port Clinton, Township of Branch, North Manheim, South Manheim, West Brunswick, Windsor (Berks County), and Tilden (Berks County) are located at the downstream limit of the West Branch of the Schuylkill River and the Schuylkill River Watersheds. Within the inundation area is a population of approximately 7,000 people.

Leaser Lake Dam is owned and operated by the Pennsylvania Fish and Boat Commission, Bureau of Engineering. The dam is a 56-foot high, 453-foot-long earthen embankment recreation dam, maintaining a normal pool of 1,657 acre-feet of water with a maximum pool capacity of 2,685 acre-feet. The dam is located across the Jacksonville Branch of Ontelaunee Creek about

½ mile above its confluence with Ontelaunee Creek and about ¾ mile northeast of Wanamakers on T 727. The inundation area resulting from a sudden dam failure follows the flood plain of Jacksonville Branch, Ontelaunee Creek, and Maiden Creek and includes portions of the village of Wanamakers and Lynn Township in Lehigh County; and portions of the villages of Trexler, Kempton, Albany, Dreibelbis, and Virginville, the Borough of Lenhartsville, Albany Township, Greenwich Township, Windsor Township, Perry Township, and Richmond Township in Berks County. The Population at Risk within the inundation area are as follows:

- Lehigh County: Approximately
    - 100 residents in 39 homes and 3 apartments
    - Approximately 15 employees/patrons in 3 businesses
- Berks County: Approximately
    - 275 residents in 120 homes
    - Approximately 55 employees/patrons in 4 businesses

Locust Creek Dam is owned by the Pennsylvania Department of Conservation and Natural Resources, Bureau of State Parks, and operated by Tuscarora State Park Manager. The dam is a 98-foot high, 750-foot-long earthen fill dam, maintaining a normal pool of 4,640 acre-feet of water with a maximum pool capacity of 7,000 acre-feet. The dam is located on Locust Creek, at Tuscarora State Park, in Rush Township in Schuylkill County. The facility is situated approximately 3.5 miles west of Tamaqua City. The inundation area resulting from a sudden dam failure is bordered:

- From Locust Creek Dam down to the intersection of Locust Creek and the Little Schuylkill River. Along Locust Creek the inundation width varies from 100 to 1500 feet in both directions.
- From this confluence down to Port Clinton (at which the Little Schuylkill River merges into the Schuylkill River). Along the Little Schuylkill River, the inundation width varies from 100 to 2000 feet on both sides.
- From Port Clinton down to the confluence of the Schuylkill River and Maiden Creek. Along the Schuylkill River the inundation width varies from 200 to 2000 feet on both sides.
- In Schuylkill County, the inundation area includes low-lying portions of Locust Lake State Park and low-lying portions along Locust Creek in Ryan and Rush Townships; along the little Schuylkill River in Rush, Schuylkill, Walker, West Penn, East Brunswick and West Brunswick Townships, and Tamaqua, New

Ringgold, and Port Clinton Boroughs; and along the Schuylkill River in Port Clinton Borough and West Brunswick Township.

- In Berks County, the inundation area includes low-lying portions along the Schuylkill River in Tilden, Windsor, Perry, Centre, Bern and Ontelaunee Townships and Hamburg, Shoemakersville, and Leesport Boroughs.

Within the inundation area is a population of approximately 3,500 residents and 800 homes, 300 businesses, 7 schools and 6 nursing homes, and one railroad within the inundation area.

Locust Lake Dam is owned by the Pennsylvania Department of Conservation and Natural Resources, Bureau of State Parks, and operated by the Locust Lake State Park Manager. The dam is a 46-foot high, 1,460-foot-long earthen fill dam, maintaining a normal pool of 620 acre-feet of water with a maximum pool capacity of 1,400 acre-feet. The dam is located on Locust Creek, at Locust Lake State Park, in Ryan Township in Schuylkill County. The facility is situated approximately 5 miles south of Mahanoy City. The inundation area resulting from a sudden dam failure is bordered:

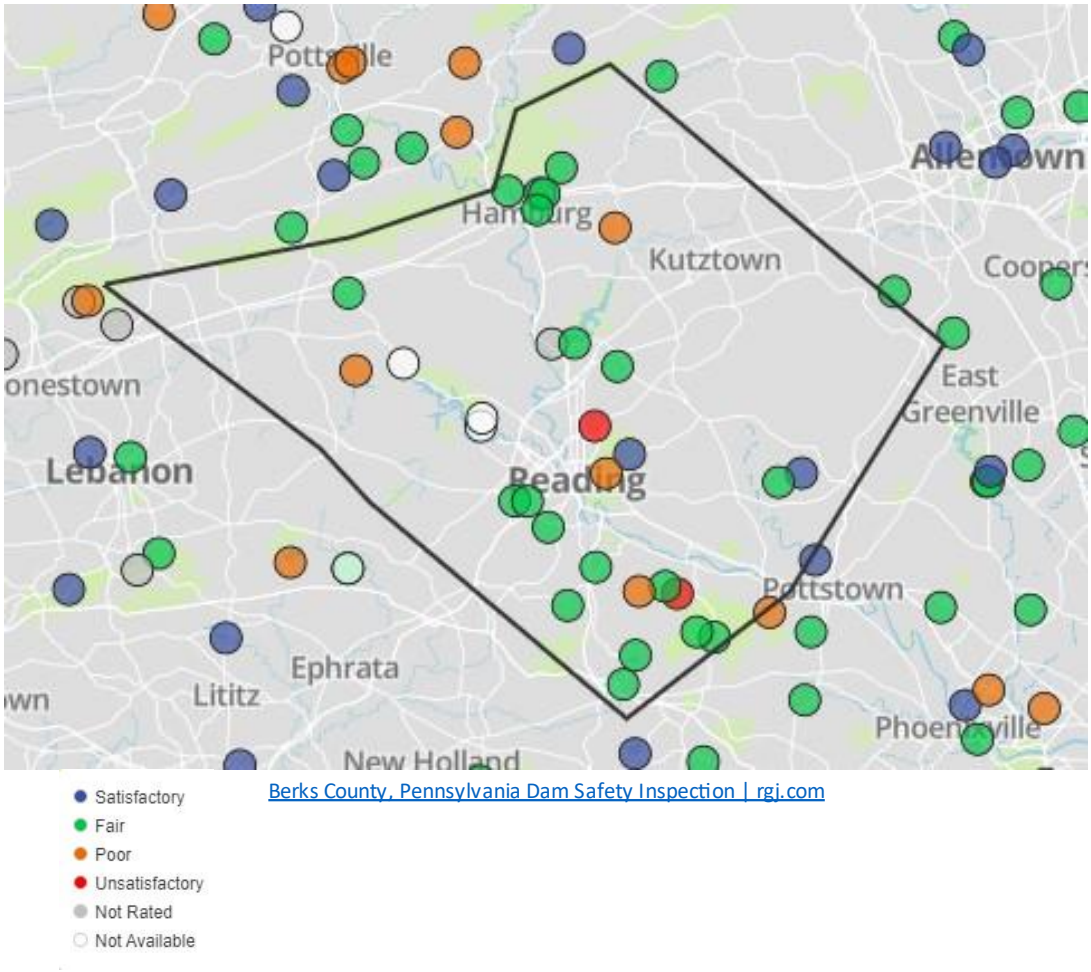
- From Locust Lake Dam down to the confluence of Locust Creek and the Little Schuylkill River. Along Locust Creel the inundation width varies from 100 to 1500 feet on both sides
- From this confluence down to Port Clinton (at which the Little Schuylkill River merges into the Schuylkill River). Along the Little Schuylkill River the inundation width varies from 100 to 2000 feet on both sides.
- From Port Clinton down to the confluence of the Schuylkill River and Maiden Creek. Along the Schuylkill River the inundation width varies from 200 to 2000 feet on both sides.
- In Schuylkill County, the inundation area includes low-lying portions of Locust Lake State Park and low-lying portions along Locust Creek in Ryan and Rush Townships; along the Little Schuylkill River in Rush, Schuylkill, Walker, West Penn, East Brunswick, West Brunswick Townships, and Tamaqua, New Ringgold, and Port Clinton Boroughs; and along the Schuylkill River in Port Clinton Borough and West Brunswick Township.
- In Berks County, the inundation area includes low-lying portions along the Schuylkill River in Tilden, Windsor, Perry, Centre, Bern and Ontelaunee Townships, and Hamburg, Shoemakersville, and Leesport Boroughs.

Within the inundation area is a population of approximately 3,500 residents, 800 homes, 300 businesses, 7 schools, 6 nursing homes, 10 daycare centers 16 churches and one railroad

within the inundation area.

Still Creek Dam is owned and operated by Tamaqua Area Water Authority. The dam is an 86-foot high, 1,160-foot-long earthen embankment dam, maintaining a normal pool of 8,287 acre-feet (2,700 million gallons) of water with a maximum pool capacity of 12,160 acre-feet (3,970 million gallons). The spillway crest and top of dam are elevation 1182.0 and elevation 1192.0, respectively. Storm releases are through a concrete overflow spillway. The dam is located on Still Creek in Rush Township, Schuylkill County about 0.8 miles upstream from the confluence with the Little Schuylkill River, about 2 miles north of Hometown. The inundation area resulting from a sudden dam failure is essentially low-lying areas, the valley floor and structures along Still Creek and the Little Schuylkill and Schuylkill Rivers through Tamaqua, New Ringgold, Port Clinton, Hamburg (Berks County) Boroughs, and Rush, Schuylkill, West Penn, Walker, East Brunswick, West Brunswick Townships, Schuylkill County, and Tilden, Windsor, Perry, and Centre Townships, Berks County, a distance of about 37 miles. Within the inundation area are approximately 3,960 residents, 1,584 homes, 507 businesses, 8 schools with a school population of 4,050, 8 daycare centers, 3 nursing homes, 16 churches and a railroad.

Berks County Department of Emergency Services will continue to work with Dam owners/operators responsible in maintaining five-year dam plans and the engineering firms contracted to write EAPs and provide inundation mapping. Also, in coordination with DEP, and our partners at Schuylkill County Office of Emergency Management in review, and comment on dam plan submissions to the county and state, and assist in concurrence signatures from county, municipal officials, NGOs, PEMA, and DEP. All dam plans are available at Berks County Department of Emergency Services for the public to view by appointment.



Locations and ratings of dams in Berks County.

Dam Classification Issues

Until recently, Pennsylvania had two systems for classifying Dams. One from the USACE and another from PADEP. The Pennsylvania Department of Environmental Protection (PA DEP) Division of Dam Safety classifies dam Hazard Potential Categories. In the Commonwealth, dams with a Hazard Potential Category of 1 (Substantial) or 2 (Few) are considered "high hazard" dams. This a different methodology than USACE. The U.S. Army Corps of Engineers (USACE) categorizes dams through Hazard Potential Classification values of Low, Significant, and High.

Not all dams categorized as "high-hazard" dams by PA DEP are classified as "high-hazard potential" dams by USACE, so counties and municipalities must utilize a separate methodology for prioritizing the dams in their jurisdiction(s). Dams that are not considered

"high-hazard" dams by PA DEP or "high-hazard potential" dams by the USACE are categorized as having a LOW priority. Dams that are considered "high-hazard" dams by PA DEP but NOT considered "high-hazard potential" dams by the USACE are categorized as having a MEDIUM priority.

The Pennsylvania Department of Environmental Protection (PA DEP) classifies dams by their size and loss potential while the U.S. Army Corps of Engineers (USACE) uses a slightly different system.

CLASS	IMPOUNDMENT STORAGE	DAM HEIGHT (feet)
A	Ecual or Greater than 50,000	Equal to or greater than 100
B	Less than 50,000 but greater than 1,000	Less than 100 but greater than 40
C	Ecual to or less than 1,000	Equal to or less than 40

CATEGORY	LOSS OF LIFE	ECONOMIC LOSS
1	Substantial (Numerous homes or small businesses or a large business or school)	Excessive such as extensive residential, commercial, or agricultural damage, or substantial public inconvenience
2	Few (A small number of homes or small businesses)	Appeciable such as limited residential, commercial, or agricultural damage, or moderate public inconvenience
3	None expected (No permanent structures for human habitation or employment)	Significant damage to private or public property and short duration public inconvenience such as damage to storage facilities or loss of critical stream crossings
4	None expected (No permanent structures for human habitation or employment)	MInimal damage to private or public property and no significant public inconvenience

PA DEP Dam Classification

Source: PAHMP 2023 appedix H

DAM HAZARD POTENTIAL CLASSIFICATION	LOW HAZARD POTENTIAL	SIGNIFICANT HAZARD POTENTIAL	HIGH HAZARD POTENTIAL
LOSS OF HUMAN LIFE	None Expected	None Expected	Probable
ECONOMIC LOSSES	Low and generally limited to owner	Yes	Yes *(but not necessary for this classification)*
ENVIRONMENTAL DAMAGES	Low and generally limited to owner	Yes	Yes *(but not necessary for this classification)*
LIFELINE INTERESTS IMPACTED	No	Yes	Yes *(but not necessary for this classification)*

USACE dam classification

Source: https://nid.sec.usace.army.mil/#/learn/manage-dams

Table 4-3 includes all dams located in Berks County, as well as their location, PA DEP and USACE hazard potential, height, and storage capacity.

TABLE 4-3
DAMS IN BERKS COUNTY AND THEIR RATINGS

Dam Name	Municipality	PADEP Class	USACE Rating	EOP*/acre feet/height
ASHLEY FURNITURE	ONTELAUNEE TOWNSHIP	C-4	Unrated	No 57 / 10
ANTHONYS MILL	UPPER TULPEHOCKEN TOWNSHIP	C-4	Significant – Fair	Yes / 12/15?
BERNHART	MUHLENBERG TOWNSHIP	C-1	High - Unsatisfactory	Yes / 203/30?
BLUE MARSH DAM	Lower Heidelberg Twp	A-1	High – Unknown	Contested?
Blue Marsh – Bernville Levee	Bernville	UNK	High - Unknown	Contested?
Blue Marsh Levees A and B	North Heidelberg	A-1	High -Unknown	Contested?
BOYERTOWN RESERVOIR	EARL TOWNSHIP	B-1	High – Sat	Yes / 156/55
CHRISTMAN	WINDSOR TOWNSHIP	C-1	High - Poor	Yes / 322/27
EGELMAN RESERVOIR	READING CITY	C-1	High – Poor	Yes / 21.4/15
GRACE MINE TAILINGS	NEW MORGAN BOROUGH	A-1	High-Fair	Yes /1650/145
GREEN HILLS LAKE	ROBESON TOWNSHIP	C-2	High-Fair	Yes /252/18
HAMBURG FLOOD CONTROL (PA-476)	WINDSOR TOWNSHIP	B-1	High- Fair	Yes /102/46
HAMBURG FLOOD CONTROL (PA-477)	WINDSOR TOWNSHIP	B-1	High - Fair	Yes/371/52

Dam Name	Municipality	PADEP Class	USACE Rating	EOP*/acre feet/height
HAMBURG RESERVOIR	WINDSOR TOWNSHIP	B-1	High - Fair	Yes / 180/53
HOPEWELL	UNION TOWNSHIP	C-1	High-Fair	Yes/943/29
INDIAN RUN	ROBESON TOWNSHIP	C-1	High- Unsatisfactory	Yes 92/40
KAERCHER CREEK (PA 478)	WINDSOR TOWNSHIP	B-1	High - Fair	Yes 1089/56
LAKE ANTIETAM	LOWER ALSACE TOWNSHIP	B-1	High- Satisfactory	Yes / 430 / 60
LAKE ONTELAUNEE	ONTELAUNEE TOWNSHIP	B-1	High – Fair - EOP	Yes 22,780 /51
LAUER RUN DETENTION BASIN	WYOMISSING BOROUGH	C-3	Significant-Fair	Yes / 18 /9
MAIDEN CREEK RESERVOIR	RUSCOMBMANOR TOWNSHIP	C-4	Low - Fair	No 92 /15
MILLERS	BRECKNOCK TOWNSHIP	C-1	High-Fair	Yes /33/21
MILLWATER	NEW MORGAN BOROUGH	C-1	High-Fair	Yes 210 /26
NEW KERNSVILLE	WINDSOR TOWNSHIP	B-1	High - Fair	Yes 1260 / 45
PALMER	JEFFERSON TOWNSHIP	C-4	Low – Poor	No / 62 / 20
ROCK HOLLOW ROAD	ROBESON TOWNSHIP	C-4	Low – Poor	No / 56 / 26
SCOTTS RUN	UNION TOWNSHIP	C-1	High-Fair	Yes 425 / 34
SHILLINGTON MEMORIAL PARK	SHILLINGTON BOROUGH	C-3	Significant-fair	Yes / 7 / 8
STANFORD AVENUE DETENTION BASIN	SPRING TOWNSHIP	C-1	High – Fair	Yes / 135 / 27
STINSON RUN	ROBESON TOWNSHIP	C-4	Fair-Low	No / 55 / 29
TROUT RUN	EARL TOWNSHIP	A-1	High – Fair	Yes / 1513 / 104

**EOP – Emergency Operation Plan*

To reconcile the differences between the PA DEP and USACE dam rating systems, PEMA developed a combined method of classifying dams that has been coordinated with and is acceptable to FEMA Region III. The PEMA Dam Risk Prioritization score is based on a calculation of probability times impact and complexity.

Dam Risk Prioritization Calculation
Dam Risk Prioritization Score = Probability x (Impact + Complexity)

TABLE 4-4
DAM RISK

Category	*Degree of Risk*		
	Level	*Criteria*	*Value*
Probability of Failure based on Condition Rating	Unlikely for failure	Condition rating of dam is **Satisfactory**. No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the minimum applicable state or federal regulatory criteria or tolerable risk guidelines.	1
	Possible for failure	Condition rating of dam is **Fair.** No existing dam safety deficiencies are recognized for normal operating conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.	2
	Likely for failure	Condition rating of dam is **Poor**. A dam safety deficiency is recognized for normal operating conditions which may realistically occur. Remedial action is necessary. POOR may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Investigations and studies are necessary	3
	Highly likely for failure	Condition rating of dam is **Unsatisfactory/ N/A.** A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution. Or the dam has not been inspected, is not under state jurisdiction, or has been inspected but, for whatever reason, has not been rated.	4
Impact	Minor	**10% or less** of population and structures of affected municipalities are within the inundation area. Only **minor property damage** and minimal disruption on quality of life. **Temporary shutdown** of critical facilities.	1
	Limited	**More than 10%** of population and structures of affected municipalities are within the inundation area. **More than 10%** of properties in affected area are **damaged or destroyed.**	2

Category	Degree of Risk		
	Level	Criteria	Value
	Critical	Minor injuries only. Complete shutdown of critical facilities for **more than one day**. **More than 25%** of population and structures of affected municipalities are within the inundation area. **More than 25%** of properties in the affected area are **damaged or destroyed.** Complete shutdown of critical facilities for **more than one week**.	3
	Catastrophic	**50% or higher** of population and structures of affected municipalities are within the inundation area. High number of **deaths/injuries possible**. **More Than 50%** of property in the affected area are **damaged or destroyed**. Complete shutdown of critical facilities for **30 Days or more**.	4
Complexity	Mild	**Single jurisdiction** affected and uses its **local emergency response agencies.**	1
	Moderate	**Multiple jurisdictions affected** and response agencies require **mutual aid support**.	2
	High	**Multiple jurisdictions** that require **County coordination.**	3
	Very High	**Multiple jurisdictions and counties** that require **Commonwealth coordination**.	4

In terms of assessing risk from dam failure for hazard mitigation planning purposes, specifically to meet the requirements of FEMA's HHPD program, counties and municipalities should prioritize their dams as follows:

Low Priority	The dam is not considered a "high-hazard" dam by PA DEP or a "high-hazard potential" dam by the USACE.
Medium Priority	The dam is considered a "high-hazard" dam by PA DEP but is not considered a "high-hazard potential" dam by the USACE. - OR - The dam is considered a "high-hazard" dam by PA DEP and is considered a "high-hazard potential" dam by the USACE and receives a Dam Risk Prioritization score of less than 17.
High Priority	The dam is considered a "high-hazard" dam by PA DEP and is considered a "high-hazard potential" dam by the USACE and receives a Dam Risk Prioritization score of 17 or more.

Table 4-5 below lists the Hazard Potential for all dams in Berks County using the PEMA method of scoring. No dams in Berks County have a prioritization score of 17 or more;

therefore, there are no High Priority dams in Berks County.

TABLE 4-5
DAMS IN BERKS COUNTY AND THEIR HAZARD POTENTIAL

LIST OF DAMS IN BERKS COUNTY FEMA/PEMA HHPD METHODOLOGY						
	Dam Name	**Municipality**	**Probability of failure based on condition**	**Impact of Failure**	**Complexity**	**Hazard Potential**
1	Ashley Furniture	ONTELAUNEE TOWNSHIP	1	1	1	2
2	ANTHONYS MILL	UPPER TULPEHOCKEN TOWNSHIP	1	1	1	2
3	BERNHART	MUHLENBERG TOWNSHIP	4	3	1	13
4	BLUE MARSH DAM	Lower Heidelberg Twp	2	4	4	12
5	Blue Marsh – Bernville Levee	Bernville	1	2	2	4
6	Blue Marsh Levees A and B	North Heidelberg	1	2	2	4
7	BOYERTOWN RESERVOIR	EARL TOWNSHIP	1	3	2	5
8	CHRISTMAN	WINDSOR TOWNSHIP	3	3	2	11
9	EGELMAN RESERVOIR	READING CITY	3	2	1	7
10	GRACE MINE TAILINGS	NEW MORGAN BOROUGH	2	4	2	10
11	GREEN HILLS LAKE	ROBESON TOWNSHIP	2	2	2	6
12	HAMBURG FLOOD CONTROL (PA-476)	WINDSOR TOWNSHIP	2	3	2	8
13	HAMBURG FLOOD CONTROL (PA-477)	WINDSOR TOWNSHIP	2	3	2	8
14	HAMBURG RESERVOIR	WINDSOR TOWNSHIP	2	3	2	8
15	HOPEWELL	UNION TOWNSHIP	2	3	2	8
16	INDIAN RUN	ROBESON TOWNSHIP	4	2	1	9

LIST OF DAMS IN BERKS COUNTY FEMA/PEMA HHPD METHODOLOGY						
	Dam Name	**Municipality**	**Probability of failure based on condition**	**Impact of Failure**	**Complexity**	**Hazard Potential**
17	KAERCHER CREEK (PA 478)	WINDSOR TOWNSHIP	2	3	1	7
18	LAKE ANTIETAM	LOWER ALSACE TOWNSHIP	2	4	3	11
19	LAKE ONTELAUNEE	ONTELAUNEE TOWNSHIP	3	4	4	16
20	LAUER RUN DETENTION BASIN	WYOMISSING BOROUGH	2	3	1	7
21	Maiden Creek Reservoir	RUSCOMBMANOR TOWNSHIP	2	1	1	3
22	MILLERS	BRECKNOCK TOWNSHIP	2	2	1	3
23	MILLWATER	NEW MORGAN BOROUGH	2	3	1	7
24	NEW KERNSVILLE	WINDSOR TOWNSHIP	2	3	3	9
25	Palmer	JEFFERSON TOWNSHIP	3	2	1	7
26	Rock Hollow Road	ROBESON TOWNSHIP	3	1	1	4
27	SCOTTS RUN	UNION TOWNSHIP	2	3	2	8
28	SHILLINGTON MEMORIAL PARK	SHILLINGTON BOROUGH	2	1	1	3
29	STANFORD AVENUE DETENTION BASIN	SPRING TOWNSHIP	2	3	1	7
30	Stinson Run	ROBESON TOWNSHIP	2	1	1	3
31	TROUT RUN	EARL TOWNSHIP	2	3	3	9

4.3.1.2 Range of Magnitude – Dam Failure

Dam failures can pose a serious threat to communities located downstream from major dams. The impact of a dam failure is dependent on the volume of water impounded by the dam and the development located downstream. Catastrophic failures are characterized by the sudden, rapid and uncontrolled release of impounded water from a water body.

Dam failures may not leave enough time for evacuation of people and property if dams deteriorate abruptly. Seepages in earth dams may develop gradually, and, if the embankment damage is detected early, downhill residents have at least a few hours or days to evacuate. Failures of concrete or masonry dams, though very rare, would occur suddenly, sending a wall of water and debris down a stream valley at great speeds. Dam failures due to overtopping of a dam may give sufficient lead time for evacuation if the rising waters and deteriorating conditions are monitored.

As discussed in section 4.3.1.2, PEMA and FEMA have agreed to a combined standard for estimating the magnitude of the hazard from Dam Failure. It is interesting to note that the five dams of concern to the HMP Update Steering Committee, do not rate a 17 or higher on the new scale. This difference is because the steering committee focused primarily on impoundment size and population in the inundation area, while the USACE/DEP/FEMA/PEMA analysis included dam condition and complexity of the issue.

4.3.1.3 Past Occurrence – Dam Failure

There have been no FEMA disaster declarations associated with dam failure in Berks County. Additionally, there are no recorded incidents of dam failures in Berks County.

4.3.1.4 Future Occurrence – Dam Failure

As previously stated, Berks County has thirty-one dams throughout the County. There are no recorded incidents of dam failures in Berks County, and future occurrences are not likely if dam maintenance and inspections continue on a regular basis to prevent failure. There are several ways a dam can fail, such as foundation failure due to seepage, settling, or earthquake; the design, construction, materials, or operation were deficient; or flooding exceeds the capacity of the dam's spillway. These are all possible scenarios for Berks County's dams; however, most can be prevented with regular maintenance and repair. Dam failures, in general, are not common and are usually caused by flooding from severe storms, hurricanes, and prolonged periods of precipitation. It is believed that climate change will cause more occurrences of severe storms in the future, therefore increasing the chances of dam failures.

In the past few years, Pennsylvania has been actively removing obsolete, low-head dams across the state that do not provide drinking water or create reservoirs for flood control. Berks County has had 11 dams removed since 2000 (American Rivers). In addition, one of Berks

County's high-hazard dams, the Kernsville Dam, is planned to be removed by PA DEP in the near future. No new dams are planned to be constructed in Berks County, and the Commonwealth will continue to remove obsolete dams, therefore reducing the already-low chance of dam failure in the future.

4.3.1.5 Vulnerability Assessment – Dam Failure

As previously mentioned, 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.

The Bernville Protective Works, an appurtenant structure to Blue Marsh Dam, is located approximately 8.7 river miles upstream from Blue Marsh Dam. The protective works consists of a main levee, a flanking levee, a pump station, and two detention dams. The system provides protection to the Borough of Bernville during periods of high lake levels. There are earth fill dikes constructed along three natural saddles where the elevation was lower than the dam crest height. A separate fact sheet was prepared for the Bernville Levee due to its completely separate consequence area. In addition, a separate fact sheet was also prepared for saddle Dikes A and B, which have a slightly different consequence area from the main dam and saddle Dike C.

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 1 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.

4.3.2 Drought

4.3.2.1 Location and Extent - 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.

4.3.2.2 Range of Magnitude – Drought

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 (Table 4-3), Crop Moisture Index, departure from normal precipitation, accumulated departure from normal stream flow, low-flow frequency estimates, groundwater levels, and lake/water storage levels.

TABLE 4-6
CLASSIFICATION OF THE PALMER DROUGHT SEVERITY INDEX

PDSI Calculated Value	Classification
4.0 or more	Extremely wet
3.0 to 3.99	Very wet
2.0 to 2.99	Moderate wet
1.0 to 1.99	Slightly wet
0.5 to 0.99	Incipient wet spell
0.49 to -0.49	Near normal
-0.5 to -0.99	Incipient dry spell
-1.0 to -1.99	Mild drought
-2.0 to -2.99	Moderate drought
-3.0 to -3.99	Severe drought
-4.0 or less	Extreme drought

TABLE 4-7
PRECIPITATION DEFICIT DROUGHT INDICATORS FOR PA (PA DEP)

Duration of Deficit Accumulation (months)	Drought Watch (deficit as percent of normal precipitation)	Drought Warning (deficit as percent of normal precipitation)	Drought Emergency (deficit as percent of normal precipitation)
3	25	35	45
4	20	30	40
5	20	30	40
6	20	30	40
7	18.5	28.5	38.5
8	17.5	27.5	37.5
9	16.5	26.5	36.5
10	15	25	35
11	15	25	35
12	15	25	35

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.

4.3.2.3 Past Occurrence - Drought

Analysis of Berks County's disaster history (see Table 4-1) 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 (DRBC) declared a conditional drought emergency due to low reservoir levels. Later that year (July 20, 1999), 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; 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. 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 the 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.

The drought of 2015 reminded residents of Berks County how important water conservation can be during times of below-average precipitation. Residents recalled how February 2015 had above-average temperatures, initiating spring in the middle of meteorological winter. These increased durations of above-average temperatures and delayed spring precipitation resulted in the eventual drought of 2015. Relief from the drought was resolved by tropical rains in September 2015.

4.3.2.4 Future Occurrence – Drought

There have been six disaster declarations for drought since 1958 (Table 4-1) in Berks County, indicating that droughts occur frequently. The chance of drought is dependent on seasonal weather patterns, although most droughts in Pennsylvania begin with minimal snowfall through the winter, thus decreasing the groundwater table index. Meteorologists believe increases in drought will be reflected by the increases in vast climate change, as described below (TWC). Dry weather is common in Berks County during the mid- to late-summer months and sometimes early fall. As such, future occurrences of drought are likely to be common and frequent.

Climate change also plays a role in predicting future occurrences of drought. Although climate change is predicted to increase precipitation events, elevated temperatures will also cause increased evapotranspiration (warmer air can hold more water vapor). According to the National Weather Service, climate change will cause an accelerated hydrologic cycle which will result in more severe droughts.

4.3.2.5 Vulnerability Assessment – Drought

Droughts primarily affect water supply and the agricultural sector. All areas of the County are vulnerable to the effects of water supply reductions; however, areas where residents rely on private water wells, typically more rural areas, are more susceptible than areas that rely on public water supply. The northern half of the County has high concentrations of agricultural land. According to the 2017 Census of Agriculture, Berks County has 222,722 acres of land in agriculture which produces $554,656,000 in market value of agricultural products sold. Droughts could severely impair the local economy by impacting the livelihood of residents within agricultural communities.

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.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss for drought in Berks County was calculated to be $4,725,282.

4.3.3 Flooding

4.3.3.1 Location and Extent – 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.

In addition to basic riverine/overbank flooding (such as what 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 water-courses 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.

Figure 4-1.1 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 4-1.1, most of these watercourses have delineated floodplains established by FEMA through the NFIP. These delineated floodplains show the estimated area of inundation associated with the 100- and 500-year storm events.

Figure 4-1.2 was developed to compare the updated FEMA 100-year floodplain, adopted by Berks County in March 2017, to the previous FEMA 100-year floodplain (2012). Figure 4-1.2 illustrates the changes to the updated 2017 100-year floodplain in green for Zone AE and in purple for Zone A, as defined in the legend. The original FEMA 100-year floodplain (2012) is shown in blue. The purpose of Figure 4-1.2 is to highlight the areas where the 2017 updated 100-year floodplain was expanded. Figure 4-1.1 only includes the current (2017) 100-year floodplain for reference.

Review of FEMA's Provisionally Accredited Levees (PALs) identified three levees within Berks County that were reviewed for PAL status. According to FEMA, whenever a community

with an existing levee updates its FIRMs, the levee owner is required to provide proper documentation to certify that the levee still meets the minimum federal requirements. The PAL process allows levee owners to document the conditions of the levee without using a professional engineer. Of the three levees within Berks County that were reviewed under the PAL conditions survey, only the Bernville Levee System was found to be an accredited levee. The Schuylkill River Floodwall System was determined ineligible, and the Trout Run Floodwall System was listed as de-accredited. Figures 4-1.1 and 4-1.2 illustrate the locations of the referenced levees.

4.3.3.2 Range of Magnitude – Flooding

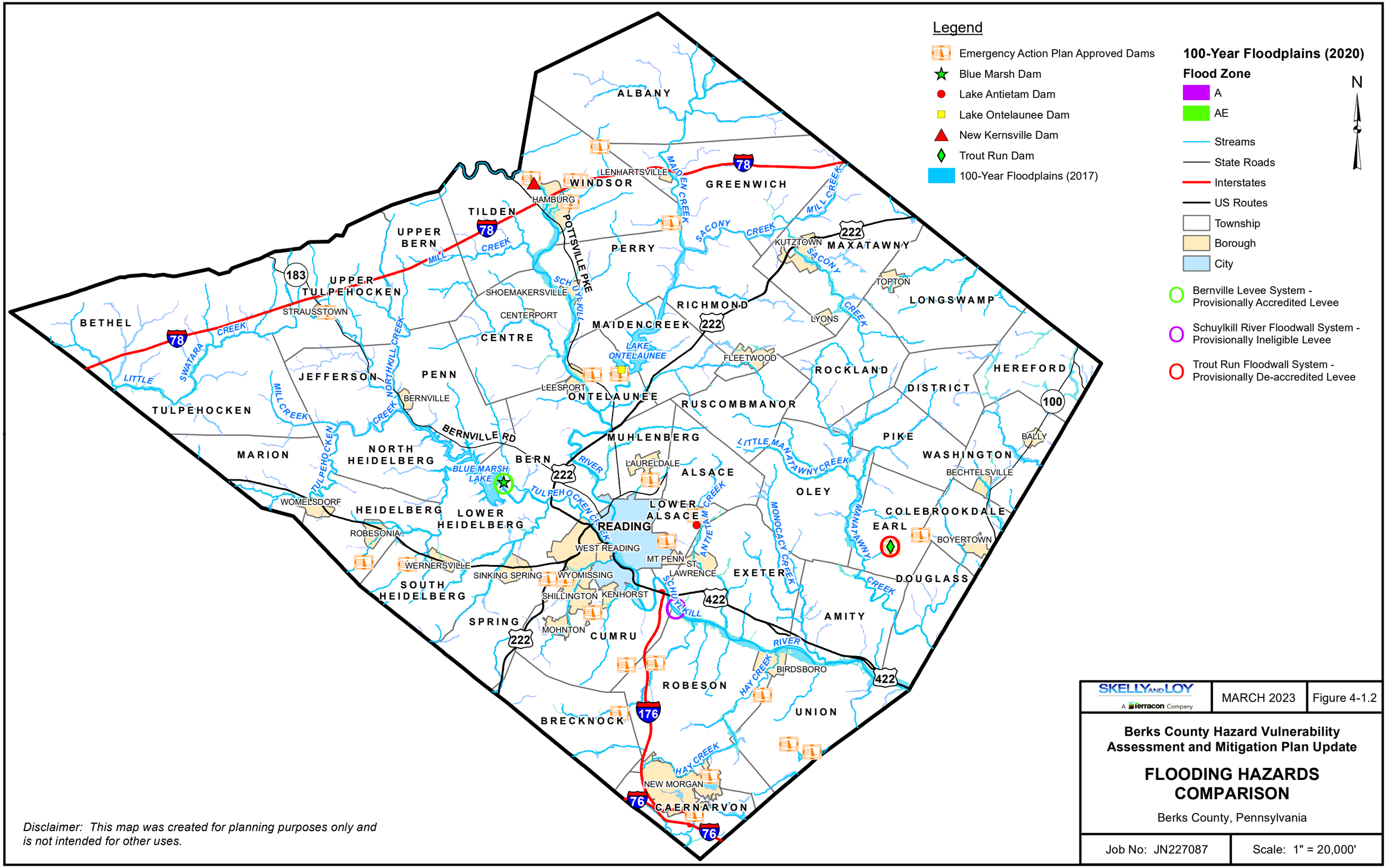
Localized and widespread floods are considered hazards when people and property are affected. Injuries and deaths can occur when people are swept away by flood currents or when bacteria and diseases are spread by moving water or stagnant floodwaters. Most property damage results from inundation by sediment filled water. A large amount of rainfall over a short time span can result in flash flood conditions. Small amounts of rain can result in floods in locations where the soil is frozen or saturated from a previous wet period or if the rain is concentrated in an area of impermeable surfaces such as large parking lots, paved roadways, or other impervious developed areas. Conditions can be exacerbated by obstructions, which prevent normal flow through the waterway, such as fallen trees.

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover, and rate of snowmelt. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover. Many areas of the County, especially along the ridge to the north of I-78, have relatively steep topography, which promotes quick and flash flood surface water runoff. Also, urbanization typically results in the replacement of vegetative ground cover with asphalt and concrete, increasing the volume of surface runoff and stormwater, particularly in areas with poorly planned stormwater drainage systems. Additionally, stormwater-caused erosion, and the resulting deposition od sediment, can alter stream channels and further endanger aquatic life.

In Berks County, there are seasonal differences in how floods are caused. In the winter and early spring (February to April), major flooding has occurred as a result of heavy rainfall on snowpack throughout contributing watersheds. Winter floods also have resulted from runoff of intense rainfall on frozen ground. Summer floods have occurred from intense rainfall on previously saturated soils. Summer thunderstorms deposit large quantities of rainfall over a short period of

2004 Flooding on Manatawny Creek

time that can result in flash flood events. In addition, the County occasionally experiences intense rainfall from tropical storms in late summer and early fall.



Disclaimer: This map was created for planning purposes only and is not intended for other uses.

SKELLY AND LOY A ferracon Company	MARCH 2023	Figure 4-1.2

Berks County Hazard Vulnerability Assessment and Mitigation Plan Update

FLOODING HAZARDS COMPARISON

Berks County, Pennsylvania

Job No: JN227087	Scale: 1" = 20,000'

4.3.3.3 Past Occurrence – Flooding

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 1700s. 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 1800s, 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, an increase in temperature, and over six 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 remained 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 eight inches in 24 hours. The Schuylkill River crested at 4:30 A.M. on June 23, 1972, at 31.5 feet in Reading, almost three times the 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).

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.

Berks County experienced a severe flash flooding event in June 2001 that caused an estimated $15 million in damage. The County was declared a federal disaster. Storm precipitation estimates were between six and eight 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 five and six inches. Over 13 inches of precipitation fell in July at Reading Regional Airport, the wettest July on record and the third wettest month on record.

2006 Flooding in Reading City along the Schuylkill River

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 Hurricane 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 United States 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.

Hurricane Irene caused flooding throughout Berks County and resulted in 3.26 inches above-normal rainfall for the month of August 2011 in Reading. The majority of rainfall occurred on August 27 and 28, when 3.04 inches were received in Reading (www.nws.noaa.gov). The Governor issued a Proclamation of Emergency as a result of the flooding and wind damage.

Hurricane Irene was identified as one of the top ten most damaging storms along the east coast due to the cost of repairs. As storm damage victims were recovering from the remnants of Hurricane Irene, a second – more damaging – storm was developing over the Atlantic Ocean. Berks County soils were both saturated and, to some extent, inundated prior to the arrival of Tropical Storm Lee; therefore, the majority of rainfall received resulted in stormwater runoff.

Berks County started to receive rainfall from Tropical Storm Lee on September 4, 2011, and the precipitation continued through September 8, 2011. As a result, Tropical Storm Lee was the fourth-greatest rainfall total in Berks County since 1869. The greatest rainfall totals were received in western Berks County in the range of ten inches of rain during this five-day period. Reading Regional Airport received 11.69 inches of rain for the month of September; 7.81 inches were received from Tropical Storm Lee alone.

Hurricane Sandy in October 2012 also caused flooding and severe wind damage throughout Berks County. The rainfall totaled only 2.01 inches in Reading, Pennsylvania (www.wunderground.com), but as the eye of the hurricane traveled from east to west near the Mason Dixon line, wind gusts exceeded 60 miles per hour (mph) within Berks County. A Governor's Proclamation and the President's Declaration of Emergency Disasters were issued for this storm as severe damage was experienced as far south as North Carolina and as far north as the New England states.

June 2013 was the wettest month of the year in Berks County. Flash flooding occurred from a nearly stationary front that caused heavy rain and thunderstorms combined with extremely wet antecedent conditions on June 30. Two to three inches of rain were recorded throughout the County, and small creeks and roadways were flooded. This event prompted a Major Disaster Declaration for the County.

Heavy rain on April 30, 2014, caused widespread poor drainage and creek flooding throughout the County. The Manatawny Creek crested above flood stage, and the Schuylkill River had its highest crest since Tropical Storm Floyd in September 1999. The heaviest precipitation fell in the eastern part of the County, and totals were recorded between three and six inches. The heavy rain was caused by a combination of a strong high-pressure system that built over the Canadian Maritimes and initiated onshore flow and a strong, but slow-moving, low-pressure system.

The summer of 2018 was determined to be one of the wettest summers in Berks County history. Governors Proclamations and Major Disaster Declarations were made in June, July, and August of 2018 for severe storms and flooding. Multiple heavy rain events occurred causing flash flooding throughout most of the County.

In late August and early September 2021, remnants of Hurricane Ida brought 4.5 inches of rain to the County over the course of two days. The Schuylkill River crested at 17.02 feet in Reading where the flood stage is 15.5 feet. This event prompted a Major Disaster Declaration and Governors Proclamation for the County.

For most communities that participate in the NFIP (see Table 4-5), FEMA has prepared a detailed FIS. Appendix L includes the NFIP worksheets for each municipalities administration of the NFIP. The FIS presents water surface elevations for floods of various magnitudes, including the flood that has a 1% 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% 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 FIRMs. 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 4-1.1) as the maximum magnitude of flood hazard for study in this plan.

TABLE 4-8
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 Township	421046	09/30/88	07/03/12	21	1,902,100	13,447
Alsace Township	421376	04/01/81	07/03/12	1	177,000	668
Amity Township	420124	07/18/77	07/03/12	27	6,676,000	32,010
Bally Borough	420125	08/01/01	07/03/12	0	0	0
Bechtelsville Borough	420126	05/15/84	07/03/12	18	3,370,000	19,414
Bern Township	421050	11/19/80	07/03/12	3	950,000	3,660
Bernville Borough	421051	12/06/83	03/21/17	0	560,000	0
Bethel Township	421052	07/15/88	07/03/12	4	1,180,000	3,558
Birdsboro Borough	420127	12/18/79	07/03/12	17	6,002,200	20,344
Boyertown Borough	420128	06/25/76	07/03/12	0	0	0
Brecknock Township	421053	06/15/81	07/03/12	2	274,800	1,051
Caernarvon Township	421055	01/16/81	07/03/12	9	5,955,000	42,069
Centerport Borough	420129	07/16/82	07/03/12	0	386,300	0
Centre Township	421056	12/16/80	03/21/17	6	1,099,400	9,397
Colebrookdale Township	421057	05/01/84	07/03/12	11	2,155,000	8,821
Cumru Township	420130	10/03/79	07/03/12	15	3,019,700	10,188
District Township	421378	08/19/85	07/03/12	1	67,500	849

TABLE 4-8
(CONTINUED)

MUNICIPALITY	COMMUNITY ID#	DATE OF ENTRY	CURRENT EFFECTIVE MAP	POLICIES IN FORCE	INSURANCE IN FORCE ($)	WRITTEN PREMIUMS IN FORCE
Douglass Township	420131	08/15/77	07/03/12	24	4,948,300	43,166
Earl Township	420132	07/18/77	07/03/12	8	1,441,700	8,371
Exeter Township	421063	03/15/82	07/03/12	55	11,260,400	35,439
Fleetwood Borough	420133	02/02/89	07/03/12	4	859,100	3,152
Greenwich Township	421067	02/17/89	07/03/12	11	1,846,000	13,929
Hamburg Borough	420134	02/15/80	07/03/12	39	5,751,600	63,636
Heidelberg Township	421069	05/03/90	03/21/17	8	2,881,400	7,919
Hereford Township	421379	05/03/90	07/03/12	8	1,865,400	10,373
Jefferson Township	421071	09/01/87	03/21/17	2	454,000	2,300
Kenhorst Township	420135	02/15/78	07/03/12	1	250,000	1,194
Kutztown Borough	420136	05/02/77	07/03/12	28	6,702,500	51,307
Laureldale Borough	422646	11/30/78	NSFHA	0	0	0
Leesport Borough	420138	05/16/77	07/03/12	13	3,061,000	33,909
Lenhartsville Borough	420139	02/17/89	07/03/12	1	350,000	494
Longswamp Township	421380	07/03/90	07/03/12	4	1,300,000	8,696
Lower Alsace Township	420140	07/05/77	07/03/12	17	3,578,000	8,592
Lower Heidelberg Township	421077	08/16/82	03/21/17	14	3,471,900	8,660
Lyons Borough	N/A	N/A	N/A	N/A	N/A	N/A
Maidencreek Township	421078	03/16/81	07/03/12	16	4,463,000	8,413
Marion Township	421079	03/02/89	07/03/12	4	819,000	2,616
Maxatawny Township	421381	11/05/80	07/03/12	13	2,273,800	17,111
Mohnton Borough	420142	07/02/80	07/03/12	10	2,080,000	13,077
Mount Penn Borough	420143	07/31/78	NSFHA	0	0	0
Muhlenberg Township	420144	09/01/77	07/03/12	59	13,565,200	65,282
New Morgan Borough	422755	04/20/98	07/03/12	0	0	0
North Heidelberg Township	421086	03/18/83	03/21/17	4	845,000	3,119
Oley Township	420965	09/14/90	07/03/12	23	4,720,900	20,854
Ontelaunee Township	420966	06/01/77	07/03/12	13	3,098,600	19,305
Penn Township	421091	07/15/88	03/21/17	1	54,100	873
Perry Township	421093	08/16/82	07/03/12	19	2,717,700	20,522
Pike Township	421382	07/18/83	07/03/12	6	1,375,000	4,627
Reading City	420145	09/29/78	07/03/12	45	24,473,700	245,397
Richmond Township	421096	09/17/82	07/03/12	10	1,947,800	12,138
Robeson Township	420146	09/03/80	07/03/12	33	8,212,100	48,887
Robesonia Borough	420147	06/18/90	07/03/12	6	1,089,000	5,536
Rockland Township	421098	09/02/88	07/03/12	3	770,000	2,000
Ruscombmanor Township	421099	02/02/89	07/03/12	4	608,000	3,213
Shillington Borough	420148	08/01/77	07/03/12	3	685,000	4,116
Shoemakersville Borough	420149	06/15/79	07/03/12	15	2,511,000	25,088

TABLE 4-8
(CONTINUED)

MUNICIPALITY	COMMUNITY ID#	DATE OF ENTRY	CURRENT EFFECTIVE MAP	POLICIES IN FORCE	INSURANCE IN FORCE ($)	WRITTEN PREMIUMS IN FORCE
Sinking Spring Borough	420150	08/16/82	07/03/12	7	1,446,000	3,444
South Heidelberg Township	421107	05/17/90	07/03/12	13	4,183,000	14,781
Spring Township	421108	04/18/83	07/03/12	34	13,774,000	26,997
St. Lawrence Borough	420151	12/16/80	07/03/12	2	543,000	1,308
Strausstown Borough	420152	02/11/83	07/03/12	0	0	0
Tilden Township	421112	07/16/80	07/03/12	1	250,000	5,741
Topton Borough	420154	07/16/90	07/03/12	4	757,000	3,126
Tulpehocken Township	421115	08/04/88	07/03/12	2	446,000	1,289
Union Township	420155	08/15/77	07/03/12	24	5,988,500	42,981
Upper Bern Township	421118	11/05/82	03/21/17	0	0	0
Upper Tulpehocken Township	421120	07/16/82	03/21/17	1	94,000	826
Washington Township	421383	06/01/84	07/03/12	4	1,029,800	4,341
Wernersville Borough	421374	08/02/82	07/03/12	1	94,000	430
West Reading Borough	420156	03/16/76	07/03/12	9	2,245,000	10,211
Windsor Township	421125	12/16/80	07/03/12	3	665,000	1,495
Womelsdorf Borough	420157	10/15/85	07/03/12	2	430,000	1,610
Wyomissing Borough	4221375	04/18/83	07/03/12	11	3,630,000	5,812

Source: NFIP Community Status Book: https://www.fema.gov/cis/PA.html
* Data current through November 2022
** NSFHA: No special flood hazard area – All Zone C

4.3.3.4 Future Occurrence – Flooding

As previously noted, Berks County, much like many other communities in Pennsylvania, is susceptible to the problems and hazards associated with flooding. Riverine (or overbank) flooding, including flash flooding, is the type of flooding that is most common in Berks County. Generally speaking, riverine flooding is only a problem where buildings (i.e., homes, businesses, industries, etc.) have been constructed within the floodplain. Riverine flooding of a natural, undeveloped floodplain is generally not a problem and does not pose a significant threat to life and property. Therefore, the most logical way to reduce or minimize the impacts of future flood events is to restrict or limit development in the floodplain.

Fortunately, Table 4-5 indicates that the majority of Berks County's constituent municipalities participate in the NFIP and subsequently enforce local floodplain management regulations that effectively restrict or limit development in the floodplain. As such, it is reasonable to conclude that the future impacts of flooding, when such an event occurs, would not be substantively

different from those of past or historical flood events. In other words, homes and businesses that have been constructed in the floodplain (prior to the implementation of floodplain management regulations) and have been impacted by flooding in the past will likely be impacted by flooding again in the future. Conversely, all new development should be constructed in accordance with the applicable local zoning, subdivision and land development, building code, and floodplain management regulations such that vulnerability and susceptibility to flooding are significantly reduced, if not avoided altogether. Therefore, the impacts of future occurrences of flooding are less related to changes in land use and more related to the possibility of an increased frequency of occurrence.

Stormwater management is an important tool used to manage future flooding hazards as well as minimize impacts to water quality in Berks County. The County has been working diligently to follow Phase II of the National Pollutant Discharge Elimination System (NPDES) permitting process that came into effect in 2003, which ties into the 1987 Clean Water Act Amendment. Under these regulations, municipalities located in an urbanized area, as designated by 1990 and 2000 Census data, were required to apply for an NPDES permit to discharge stormwater from their system. Berks County worked to create a Municipal Separate Storm Sewer Systems (MS4) Committee in 2012 to address the management of stormwater, and to assist municipalities with these requirements.

As part of the 2023 Berks County Hazard Vulnerability Assessment and Mitigation Plan Update, coordination was completed with the MS4 Committee to identify what MS4 Best Management Practices (BMPs) exist and which MS4 BMPs are proposed in Berks County. Coordination began with the July 21, 2022, Berks County MS4 Steering Committee to learn how coordination is taking place in the County and to verify the locations of MS4 projects. Figure 4-1.3 illustrates the areas of nine MS4 projects throughout the County. The majority of the MS4 projects are related to streambank restoration, floodplain restoration, wetland restoration, or flood debris removal.

The purpose of highlighting these projects is for other municipalities within Berks County to see representative examples of MS4 types of projects, including Green Stormwater Infrastructure. In addition, this allows for future planning efforts to focus on prioritization of MS4 projects within source water protection zones for surface water as outlined in blue on Figure 4-1.3 and source water protection zones for groundwater as outlined in brown on Figure 4-1.3.

For the purposes of this Hazard Mitigation Plan Update, it is important to note that Berks County has not been subject to any substantive changes in regional geography, physiography, land use, population, or socioeconomic conditions that would render the county any more or less

susceptible to flooding than five years ago. Therefore, the key factor in determining the potential for an increased future occurrence of flooding is that of climate change. Most of the world's climate scientists agree that climate change is happening, that it is caused by human burning of fossil fuels, and that it has the potential to alter the world's weather patterns. While there is no general consensus on exactly how climate change will impact weather patterns on a local level, the potential for increased storms, including hurricanes, does exist. This has the potential to negatively impact Berks County by increasing the future occurrence of flooding. Implementation of the mitigation strategies outlined in this hazard plan will seek to offset these future impacts.

4.3.3.5 Vulnerability Assessment – Flooding

Berks County is vulnerable to flooding that causes loss of lives, property damage, and road closures. GIS data analysis indicates that there are approximately 4,467 occupied structures in the 100-year floodplain in Berks County. Based on available GIS data and a windshield survey, assuming that 90% (4,020) of these structures are residences, 8% (357) are commercial establishments, and 2% (90) are industrial buildings, the following losses can be estimated for Berks County's flooding hazard.

Residential = 4,020 Structures X $100,000 average value per structure X 10% impact* = $40,200,000
Commercial = 357 Structures X $350,000 average value per structure X 10% impact* = $12,495,000
Industrial = 90 Structures X $1.1 million average value per structure X 10% impact* = $9,900,000
Total = $62,595,000 (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 4-15 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 4-15 indicates that the 118 identified repetitive loss properties within Berks County account for 24% of the total NFIP flood loss claims to date. Table 4-15 also indicates that the NFIP has paid over $19 million in flood insurance claims payments to Berks County residents for reported flood losses. Finally, Table 4-15 indicates that 38 (53%) of Berks County's 72 municipalities have identified repetitive loss properties. This has increased since 2018. Figure 4-5 geographically shows the density of Repetitive Loss Properties by Municipality.

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 6.3.3) but can also be used to supplement the regional flood loss estimate.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss for flooding was calculated to be $3,175,814.

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 are shown in Appendix C. The complete loss estimate results and supporting documentation for these 13 representative floodplain structures are included in the appendices.

In addition, a HAZUS report was generated for potential flood losses for the 2023 plan update. The analysis used a 100-year storm event and analyzed building exposure to floodplains. Total economic loss, which includes building loss (building, content, and inventory loss/damage) and business interruption (income, relocation, rental income, and wage), was estimated to be $397 million. Building loss was estimated to be only $675 million. The HAZUS report can be found in the appendices.

N

Albany
Windsor
Greenwich
Tilden
Upper Bern
Perry
Richmond
Maxatawny
Longswamp
Bethel
Upper Tulpehocken
Centre
Maidencreek
Rockland
District
Hereford
Tulpehocken
Jefferson
Penn
Ontelaunee
Ruscombmanor
Pike
Washington
Marion
North Heidelberg
Bern
Muhlenberg
Alsace
Oley
Heidelberg
Lower Heidelberg
Lower Alsace
Reading
Earl
Colebrookdale
Douglass
South Heidelberg
Spring
Exeter
Amity
Cumru
Brecknock
Robeson
Union
New Morgan
Caernarvon

Legend

- MS4 Locations
- Sourcewater Protection Zones (SWP) - Surface Water
- Sourcewater Protection Zones (SWP) - Groundwater
- Berks County
- MS4 Permit Required
- MS4 Waiver
- Not in MS4

ID	Municipality	ID	Municipality	ID	Municipality
58	Lenhartsville	25	Bally	31	Birdsboro
46	Hamburg	57	Laureldale	29	Bernville
55	Kutztown	26	Bechtelsville	95	Womelsdorf
85	Topton	74	Robesonia	96	Wyomissing
78	Shoemakersville	33	Boyertown	79	Sinking Spring
60	Lyons	93	West Reading	54	Kenhorst
37	Centerport	90	Wernersville	77	Shillington
44	Fleetwood	64	Mt Penn	65	Mohnton
92	Leesport	81	St Lawrence		

SKELLY AND LOY A Terracon Company | March 2023 | Figure 4-1.3

MUNICIPALITIES PERMITTED OR WAIVED FROM MS4

BERKS COUNTY MS4

BERKS COUNTY, PENNSYLVANIA

Job No. JN227087 | 1 inch = 20,000 Feet

4.3.4 Hurricanes/Tropical Storms

4.3.4.1 Location and Extent – 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., coastal storm surge), it is susceptible to the high winds, significant rainfall, and associated flooding that can sometimes occur.

Tropical storm systems (i.e., hurricanes, tropical storms, tropical depressions) impacting Berks County develop in tropical or sub-tropical waters of the Atlantic Ocean, Gulf of Mexico, or Caribbean Sea. In some cases, the center of circulation for these storm systems where wind and precipitation effects are often most intense can track inland and move directly through Pennsylvania and potentially Berks County. However, due to the size of these storms, Berks County is more often affected when circulation centers pass at a distance of several hundred miles. In either case, these coastal storms are regional events that can impact very large areas hundreds to thousands of miles across over the life of the storm.

4.3.4.2 Range of Magnitude – Hurricanes/Tropical Storms

Intense precipitation and wind resulting in flood and wind damage are the most common impacts associated with coastal storm systems in Berks County. The impact tropical storms or hurricanes have on an area is typically measured in terms of wind speed. Expected damage from hurricane force winds is measured using the Saffir-Simpson Scale (see Table 4-6). The Saffir-Simpson Scale categorizes (Category 1-5) hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential, which are combined to estimate potential damage. A category 1 hurricane is characterized as having wind speeds of 74-95 Mph and is considered very dangerous winds that will produce some damage. A Category 5 hurricane is characterized as having wind speeds in excess of 156 Mph with catastrophic damage.

TABLE 4-9
SAFFIR-SIMPSON SCALE CATEGORIES WITH ASSOCIATED WIND SPEEDS AND DAMAGES

Storm Category	Wind Speed (mph)	Description of Damages
1	74-95	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last several days to weeks.
3	111-129	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	130-156	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	>156	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

4.3.4.3 Past Occurrence – Hurricanes/Tropical Storms

Analysis of Berks County's disaster history (see Table 4-1) indicates that there have been nine 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), 2005 (Katrina), 2011 (Lee), 2012 (Sandy), 2020 (Isais), and 2021 (Ida). More detailed information on hurricane/tropical storm-related flooding can be found in Section 4.3.3.3.

4.3.4.4 Future Occurrence – Hurricanes and Tropical Storms

As mentioned above, Berks County is located too far inland to be impacted by all of the common hazards associated with a hurricane/tropical storm event, and it does not experience the

same frequency of hurricanes as more coastal regions. Hurricanes and tropical storms are not uncommon in Berks County. An increase in hurricanes and tropical storms has been trending for the East Coast in the past few years and is expected to keep increasing as a result of climate change. Berks County will most likely experience an increase in high winds, significant rainfall, and associated flooding from hurricanes and tropical storms in the future.

4.3.4.5 Vulnerability Assessment – Hurricanes/Tropical Storms

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.

HAZUS reports were generated for potential hurricane/tropical storm losses for the 2023 plan update. Reports were generated for storms with a 10-, 50-, and 100-year return period. The 10-year storm did not generate any economic loss. The 50-year hurricane generated $20,500 in economic losses, and the 100-year hurricane generated $6.2 million in economic losses. The HAZUS reports can be found in the appendices.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss from hurricanes/tropical storms in Berks County was calculated to be $279,051.

4.3.5 Land Subsidence

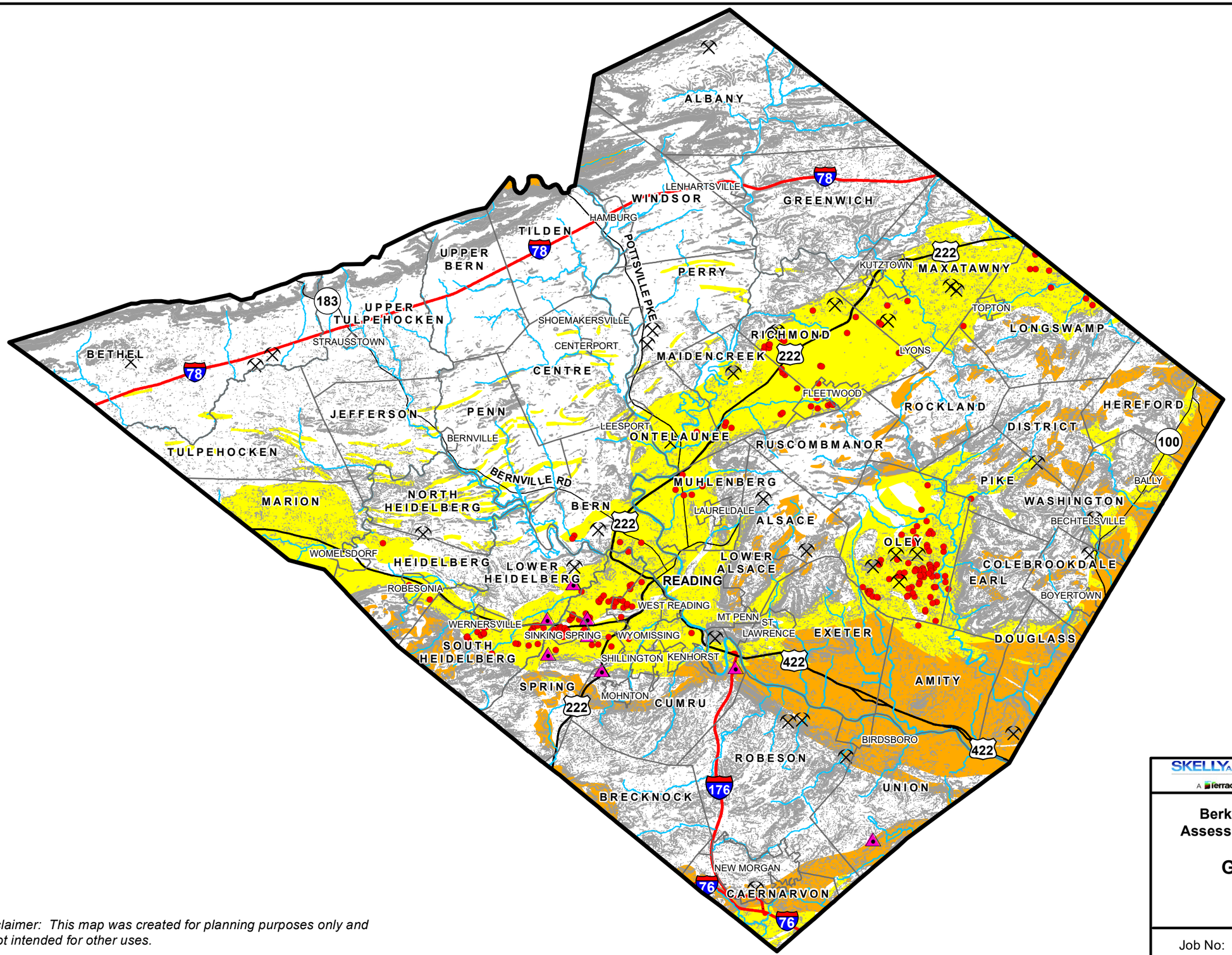
4.3.5.1 Location and Extent – Land Subsidence

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 of buildings and/or infrastructure are present.

Sinkhole in Sinking Spring Borough

Berks County is susceptible to land subsidence in two regions. According to PA DCNR, there is a band of known sinkholes and surface depressions that spans the central region of Berks County. This area is within the Allentown, Ontelaunee, Epler, 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, Exeter, and Marion Townships. There is also another area south of that belt, mainly in Oley Township, where known sinkholes and surface depressions are located.

Figure 4-2 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: This map was created for planning purposes only and is not intended for other uses.

SKELLY AND LOY, A ferracon Company | MARCH 2023 | Figure 4-2

Berks County Hazard Vulnerability Assessment and Mitigation Plan Update

GEOLOGIC HAZARDS

Berks County, Pennsylvania

Job No: JN227087 | Scale: 1" = 20,000'

4.3.5.2 Range of Magnitude – Land Subsidence

Land subsidence is not measured in magnitude on a scale like earthquakes or tornadoes in comparison. The result of land subsidence is rarely the same in any two areas. Sinkholes form in karst geology and can vary in size or depth. Magnitude is often measured in urban areas versus non-urban areas and the amount of damage that occurs. Damage related to subsidence include building damage, utilities, roads and public/private property damage. If long-term subsidence is not mitigated, loss of roadways or building can result.

4.3.5.3 Past Occurrence – Land Subsidence

Berks County had 211 sinkholes according to DCNR data as of 2013. Most recently, in February 2023, a pedestrian fell into a sinkhole while walking between a parking lot and sidewalk in Mount Penn Borough. The sinkhole was eight feet deep and the man had to be rescued by firefighters with a ladder (Reading Eagle, 2/1/2023). In September 2021, remnants from Hurricane Ida hit Berks County. Flash flooding from the more than five inches of rain in a 24-hour period caused a sinkhole to open in the Berkshire Square Shopping Plaza parking lot in Wyomissing (Berks Weekly, 9/3/2021).

The Berkshire Square Shopping Plaza sinkhole

4.3.5.4 Future Occurrence – Land Subsidence

Sinkholes exist within Berks County and will continue in the future given the amount of carbonate bedrock and karst geology that exists in the central and southeastern portions of Berks County. In addition, with above-average rain events that are predicted to occur in the future due to climate change, karst limestone geology can experience above-average subsidence rates. There is no physical advanced mitigation that can be completed where development (i.e., housing, transportation infrastructure, and commercial buildings) has occurred in carbonate bedrock; rather, only repair of subsidence once it occurs.

However, advanced outreach and further avoidance of land subsidence areas can prove to be beneficial for residents of Berks County. At the municipal level, avoiding the permitting of development in these areas can be controlled by zoning and subdivision ordinances. Further planning and research of the geologic resources can be completed for further avoidance.

4.3.5.5 Vulnerability Assessment – Land Subsidence

Berks County had 211 sinkholes according to DCNR data as of 2013, which makes Berks County a high vulnerability county for land subsidence. 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 5% of these structures (of which 90% are residences, 8% are commercial, and 2% are industrial [based on 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

4.3.6 Landslides

4.3.6.1 Location and Extent – 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 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 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 have been built to mitigate this hazard, and it is no longer considered an issue by PennDOT. Similarly, no other known landslide event locations were reported.

Figure 4-2 also shows areas in the County that have bedrock geology with poor cut-slope stability and areas with slopes greater than 15%. 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

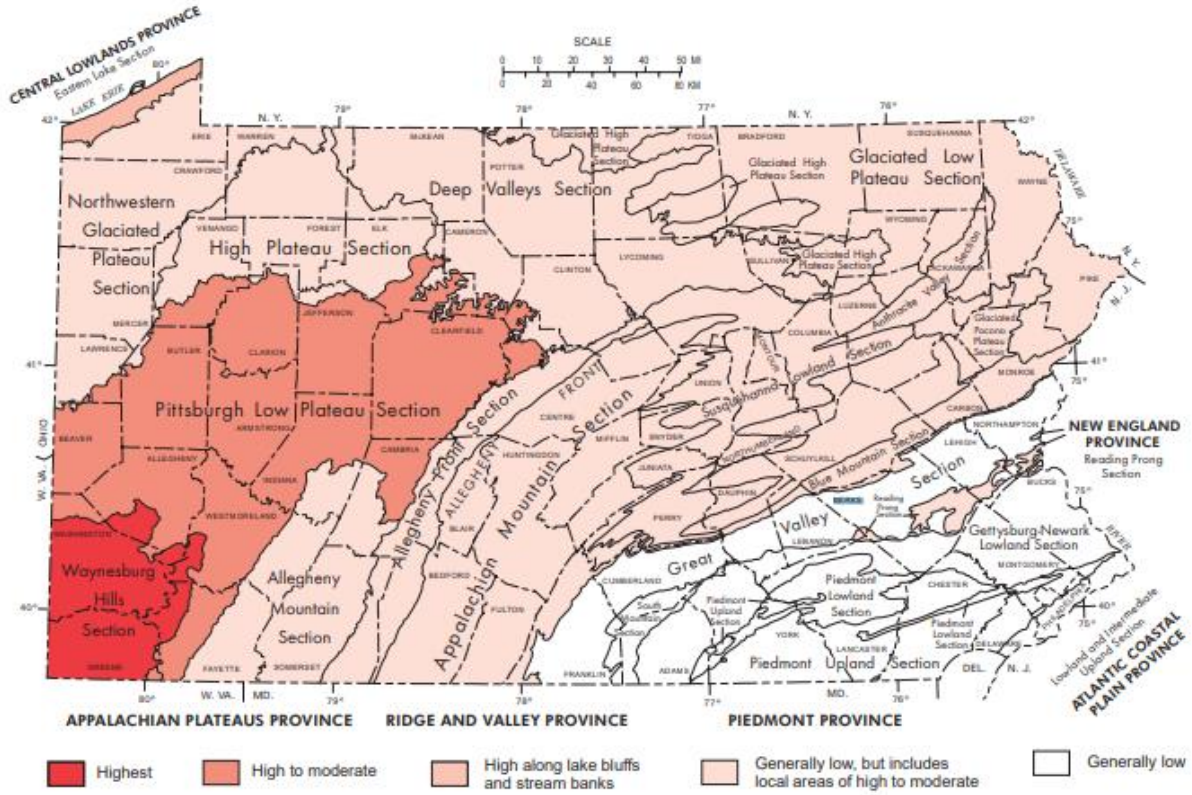
mountainous part of the County. The Mitigation Steering Committee identified these potential landslide hazard areas as the maximum physical extent of landslide hazard for study in this plan.

4.3.6.2 Range of Magnitude – Landslides

The magnitude for landslides is based on the steepness of slopes, the steeper the slope the more severity potential for landslides. Landslides often cause severe transportation issues along cut slopes of highways or railroad corridors. Deaths from landslides are rare in Berks County but can occur from falling rock and debris.

4.3.6.3 Past Occurrence – Landslides

Landslides are not common in Berks County and are usually due to human-induced activity. There are mountainous regions that are more susceptible to landslides in the northern part of Berks County; if development increases in these areas in the future, it can be assumed that the risk for landslide occurrence will also increase.



https://spcwater.org/wp-content/uploads/2020/01/DCNR_Landslides_2001.pdf

4.3.6.4 Future Occurrence – Landslides

Rock falls and rockslides are typical landslides that occur from road cuts in mountainous areas. Clearing of vegetation in sloped areas for development can also cause landslides, especially during precipitation events. The effects of climate change are predicted to increase precipitation in the future, thus increasing the chance of landslides.

4.3.6.5 Vulnerability Assessment – Landslides

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 on a windshield survey and the history of past landslide events, it is estimated that only up to 5% (233) of these structures are expected to incur losses due to a landslide event over time. As such, assuming that 95% (221) of these structures are residences and 5% (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

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss from landslides in Berks County was calculated to be $85,441.

4.3.7 Earthquakes

4.3.7.1 Location and Extent – Earthquakes

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.

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 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."

4.3.7.2 Range of Magnitude – Earthquakes

Earthquakes are measured using the Richter Scale on a range of less than 3.5 magnitude to 8.0 magnitude or greater (see Table 4-7). Richter Scale is defined as an open-ended logarithmic scale that represents the energy release of an earthquake, see Figure 4.3.7.2. In the United States, intensity is commonly measured by the Modified Mercalli Intensity Scale that is composed of 12 increasing levels of intensity from imperceptible to catastrophic (see Table 4-8).

TABLE 4-10
RICHTER SCALE MAGNITUDE AND EARTHQUAKE EFFECTS

RICHTER MAGNITUDES	EARTHQUAKE EFFECTS
Less than 3.5	Generally, not felt, but recorded.
3.5 – 5.4	Often felt, but rarely causes damage.
Under 6.0	At most, slight damage to well-designed buildings; can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive up to about 100 kilometers from epicenter.
7.0 – 7.9	Major earthquake; can cause serious damage over large areas.
8.0 or greater	Great earthquake; can cause serious damage in areas several hundred kilometers across

TABLE 4-11
MODIFIED MERCALLI INTENSITY SCALE

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	Instrumental	Usually detected only on seismographs	<4.2
II	Feeble	Felt only by a few persons at rest, especially on upper floors of buildings.	
III	Slight	Felt quite noticeably indoors, especially on upper floors. Most people don't recognize it as an earthquake.	
IV	Moderate	Can be felt by people walking; dishes, windows, and doors are disturbed.	
V	Slightly Strong	Sleepers are awoken; unstable objects are overturned.	<4.8
VI	Strong	Trees sway; suspended objects swing; objects fall off shelves; damage is slight.	<5.4
VII	Very Strong	Damage is negligible in buildings of good design and construction, slight to moderate in well-built ordinary structures, and considerable in poorly built or badly designed structures; some chimneys are broken.	<6.1
VIII	Destructive	Damage is slight in specially designed structures; considerable in ordinary, substantial buildings. Moving cars become uncontrollable; masonry fractures, poorly constructed buildings damaged.	<6.9
IX	Ruinous	Some houses collapse, ground cracks, pipes break open; damage is considerable in specially designed structures; buildings are shifted off foundations.	
X	Disastrous	Some well-built wooden structures are destroyed; most masonry and frame structures are destroyed along with foundations. Ground cracks profusely; liquefication and landslides widespread.	<7.3
XI	Very Disastrous	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed.	<8.1
XII	Catastrophic	Total destruction; trees fall; lines of sight and level are distorted; ground rises and falls in waves; objects are thrown upward into the air.	>8.1

The highest magnitude earthquake recorded in Berks County was a 4.6. Earthquakes do occur in Berks County; however, are typically not felt or felt but cause no damage.

4.3.7.3 Past Occurrence – Earthquakes

Earthquakes in Berks County are clustered around the Reading area; epicenters obtained from PA DCNR are depicted on Figure 4-2 and listed in Table 4-9. 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."

TABLE 4-12
KNOWN EARTHQUAKES IN BERKS COUNTY THROUGH OCTOBER 2022

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 Township	2.8	
January 15, 1994	Spring Township	4.0, 4.6	Two events about one hour apart; long after-shock 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	
August 23, 2011	Virginia	5.8	No damage
January 3, 2018	Reiffton	0.9	
September 12, 2018	Spring Ridge	1.7	
September 15, 2018	Spring Ridge	1.0	
December 18, 2018	Sinking Spring	1.3	
March 18, 2019	Whitefield	1.1	
April 10, 2019	Wernersville	1.6	
April 11, 2019	Wernersville	1.0	
April 20, 2019	Lincoln Park	0.9	

TABLE 4-12
(CONTINUED)

DATE/TIME	LOCATION	MAGNITUDE	REMARKS
July 19, 2019	Spring Ridge	2.0	
July 29, 2019	Greenfields	1.0	
November 4, 2019	Spring Ridge	1.3	
April 9, 2020	Shillington	1.3	
May 4, 2020	Sinking Spring	1.4	
November 7, 2021	Sinking Spring	1.7	
November 12, 2021	Wernersville	1.5	
November 13, 2021	Sinking Spring	2.1	

Source: PA DCNR Earthquake Hazards in Pennsylvania, ES 10 and PEMA

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.

A moderately significant earthquake occurred in Virginia on August 23, 2011. The 5.8-magnitude quake was felt throughout Berks County. Although there were several office buildings evacuated, no significant damage occurred due to the Virginia earthquake.

4.3.7.4 Future Occurrence – Earthquakes

Berks County is not considered a high earthquake activity area; however, earthquakes do occur occasionally. Southern Berks County is part of the Lancaster Seismic Zone, which is caused by faults that formed around 200 million years ago when Pangea began to break apart, an event known as rifting. Given there are no active plate boundary faults in Pennsylvania such as those on the West Coast, it is anticipated that earthquakes will occur at the same rate in the future. There are no environmental or human-induced factors, such as mining or injection wells, to cause an increase in earthquakes in Berks County.

4.3.7.5 Vulnerability Assessment – Earthquakes

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. An updated HAZUS report was generated for the 2023 plan update for a 5.0 magnitude earthquake with an epicenter in the middle of the county (Muhlenberg Township). The total economic loss estimated for this earthquake was $6.6 billion. The HAZUS report can be found in the appendices.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss from earthquakes in Berks County was calculated to be $475,210.

4.3.8 Severe Storms

4.3.8.1 Location and Extent – 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% are classified as severe. A thunderstorm is considered to be severe if it produces hail at least ¾ inch in diameter, wind 58 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.

4.3.8.2 Range of Magnitude – Severe Storms

There are various types of severe storms including heavy snowstorms, sleet storms, blizzards, and ice storms that are categorized as winter severe storms. Winter storms can significantly affect roadways, utilities and businesses from freezing conditions and loss of life. Closure of secondary roads, utility services and depletion of heating supplies can result. The severity of winter storms are listed below by type:

- **Heavy Snowstorm:** Accumulations of four inches or more in a six-hour period, or six inches or more in a twelve-hour period.
- **Sleet Storm:** Significant accumulations of solid pellets which form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces posing hazards to pedestrians and motorists.
- **Ice Storm:** Significant accumulations of rain or drizzle freezing on objects (trees, power lines, roadways, etc.) as it strikes them, causing slippery surfaces and damage from the sheer weight of ice accumulation.
- **Blizzard:** Wind velocity of 35 miles per hour or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile prevailing over an extended period of time.
- **Severe Blizzard:** Wind velocity of 45 miles per hour, temperatures of 10° F or lower, a high density of blowing snow with visibility frequently measured in feet prevailing over an extended period time.

Hailstorm damage can vary based on the size, duration, and intensity of hail precipitation (see Table 4-10). Automobiles, aircrafts and homes are susceptible to damage from hailstorms. In addition, severe crop damage can occur in summer and fall.

TABLE 4-13
HAILSTONE SIZE AND RELATIONSHIP TO UPDRAFT SPEED (NOAA NWS)

Hailstone Size	Measurement (inches)	Updraft Speed (mph)
BB	<0.25	<24
Pea	0.25	24
Marble	0.50	35
Dime	0.70	38
Penny	0.75	40
Nickel	0.88	46
Quarter	1.00	49
Half Dollar	1.25	54
Walnut	1.50	60
Golf Ball	1.75	64
Hen Egg	2.00	69
Tennis Ball	2.50	77
Baseball	2.75	81
Tea Cup	3.00	84
Grapefruit	4.00	98
Softball	4.50	103

4.3.8.3 Past Occurrence – Severe Storms

According to NOAA, between 1950 and 2022, Berks County reported 323 occurrences of thunderstorm-high wind events and 71 occurrences of thunderstorm-related hail in excess of ¾ inch in diameter. The largest hail ever reported in Berks County was approximately 2.5 inches in diameter (May 22, 2014). 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 three 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 and can cause permanent kidney, pancreas, and liver damage and even death.

Analysis of Berks County’s disaster history (see Table 4-1) indicates that there have been 21 disaster declarations since 1958 due to severe winter storms (heavy snow and blizzards). According to NOAA, Berks County has experienced 243 snow and/or ice events between 1950 and 2022. 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.

The Valentine’s Day winter snow/ice storm of February 14, 2007, was one of the most memorable snow storms in Berks County. Seven inches of snow were topped with three inches of ice that day, which closed down parts of I-78, along with portions of I-81 and I-80, throughout the state. Within Berks County, there were hundreds of tractor trailers, amongst other motorists, stuck in the snow on the slopes of I-78. Fuel shortages and frozen fuel lines were part of the challenges faced that day. Although the winter storm started on a Wednesday, PennDOT did not close down on-ramps until 8:00 A.M. on Thursday, February 15. Furthermore, the State Police did not close all the on-ramps between Exit 19 and Exit 49 of I-78 until 5:00 P.M. on February 15. Traffic continued to stack along I-78 and gain access on some on-ramps that were not closed along I-78. The National Guard and police provided food, fuel, blankets, and other supplies to the trapped motorists. With the aid of 141 pieces of heavy equipment used to clear the snow and ice, the I-78 corridor was re-opened on February 17, 2007, at 4:00 P.M.

A major nor’easter from January 22 to 24, 2016, produced record snowfall for eastern Pennsylvania. Berks County experienced some of the greatest snowfall totals in eastern Pennsylvania. Some parts of the County recorded up to 33.5 inches of snow. Wind gusts over 35 mph caused blizzard conditions and reduced visibility to one-quarter of a mile or less. One fatality in Berks County occurred as an indirect result from this event; a Muhlenberg Township man died from carbon monoxide poisoning after his idling vehicle was buried by snow from a passing plow. This event was declared a State of Emergency by the Governor on January 21 for the duration of the event. A Federal Disaster Declaration was also made for this event by President Obama.

4.3.8.4 Future Occurrence – Severe Storms

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.

4.3.8.5 Vulnerability Assessment – Severe Storms

The best available historic damage estimate associated with severe storms is 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.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss for severe storms (includes hail, ice storm, lightning, strong wind, and winter weather) in Berks County was calculated to be $4,453,919.

4.3.9 Tornadoes, Windstorms

4.3.9.1 Location and Extent – Tornadoes, Windstorms

Tornados are known to occur throughout Pennsylvania, including Berks County. 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.

1998 Tornado Damage in Lyons Borough

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, 1,000 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.

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 thunderstorms 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.

4.3.9.2 Range of Magnitude – Tornadoes, Windstorms

Significant damage and even fatality can result when tornadoes pass through a populated area. Lightly constructed buildings are at greatest risk including mobile homes and large outbuildings. The Enhanced Fujita Scale, or EF Scale, is used to measure a tornado's strength and associated damage (see Table 4-11). The EF Scale provides wind estimates and damage descriptions broken down into 6 categories ranging from E-0 to E-5 with winds speeds ranging from 65 MPH to over 200 MPH.

TABLE 4-14
EF-SCALE

EF-Scale	Wind Speed (MPH)	Tornado Type	Type of Damage
E-0	65-85	Weak	Minor
E-1	86-110	Weak	Moderate
E-2	110-135	Strong	Considerable
E-3	136-165	Strong	Severe
E-4	166-200	Violent	Devastating
E-5	>200	Violent	Extreme

During tornados, many fatalities occur from falling trees, blowing debris, or collapsing roofs. Windstorms including Nor'easters can also cause power outages, which can present additional hazards should the prolonged event occur during the winter months.

4.3.9.3 Past Occurrence – Tornadoes, Windstorms

Analysis of Berks County's disaster history indicated that the County experienced a tornado in May 1998 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 people 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 25 additional documented tornadoes from 1950 through 2022 in Berks County. Of the 21 documented tornadoes that have occurred in Berks County (before 2007), 2 have been categorized as F3, 8 have been categorized as F2 (117-157 mph wind speeds), 9 have been categorized as F1 (73-112 mph wind speeds), and 2 have been categorized as F0 (40-72 mph wind speeds). In 2007 the Enhanced Fujita Scale (EF) was adopted by the United States. Since 2007, there have been five recorded tornadoes in Berks County. An EF1 (86-110 mph wind speeds) occurred on July 9, 2015, in Tilden Township; an EF0 (65-85 mph wind speeds) occurred on June 19, 2017, in Shartlesville; an EF2 (111-135 mph wind speed) occurred on May 28, 2019, in Morgantown; an EF1 occurred on July 29, 2021, in Albany Township; and an EF1 occurred on August 18, 2021, in Berne Township. None of the tornadoes were declared a disaster; however, the 2015 EF1 caused $750,000 in damage to the Blue Mountain Elementary School and resulted in one injury.

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.

2015 Tornado Damage to the blue Mountain Elementary School

4.3.9.4 Future Occurrence – Tornadoes, Windstorms

Berks County rarely experiences tornadoes. In fact, since the original Hazard Mitigation Plan was prepared for Berks County in 2007 (11.5 years ago), there have been only five recorded tornadoes. The most common tornadoes in Berks County are related to larger vortex formations and often form in convective cells such as thunderstorms. It is not uncommon for tornadoes to form on the right forward quadrant of a hurricane approaching from the Atlantic Ocean, but this scenario is very rare for Berks County.

Climate change is predicted to cause more severe weather in the future and thus increase the chances for tornadoes. It is not anticipated Berks County will become part of "Tornado Alley" anytime soon; however, emergency responders and residents need to remain prepared for potential tornadoes.

4.3.9.5 Vulnerability Assessment – Tornadoes, Windstorms

Damage from a tornado generally occurs within a 500-foot swath for several miles; however, large windstorms associated with summer events or Nor'easters can cause more widespread and less severe damage. With the introduction of more stringent building codes, the risk of severe property damage continues to decrease; however, downed power lines and

impassable roads are unavoidable. Severe storms including summer and winter windstorms and tornadoes may continue cause considerable property damage.

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.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss from tornadoes in Berks County was calculated to be $3,534,543.

4.3.10 Wildfires

4.3.10.1 Location and Extent – Wildfires

Wildfires generally take place in less developed, forested areas and can spread fast depending on moisture level and available fuel. A majority of the forested areas of Berks County are located to in the northern and southern portions of the County.

On average, Pennsylvania experiences approximately 1,000 wildfires every year. The vast majority of these wildfires (90%) are 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 4-3) 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.

4.3.10.2 Range of Magnitude – Wildfires

Like most hazards, wildfires can range from small fires contained by local emergency responders to large scale fires that consume acres of land and take days to extinguish. Large scale events can be devastating, have health implications or loss of life, and cause property destruction. Wildfires and controlled burns can actually provide environmental benefit by reestablishing more diverse vegetation. Controlled burns can initiate pine and fruit seed dispersion and reduce invasive species and infestations and overgrowth. However, on the converse, there is an increased risk of flooding and erosion.

4.3.10.3 Past Occurrence - Wildfires

Coordination with the PA DCNR Bureau of Forestry indicated that Berks County has averaged approximately 13 wildfires per year over the past 25 years. On average, these wildfires account for approximately 39 acres of burned area per year, which equates to an estimated average burned area of three acres per fire. The largest wildfire in Berks County in the last 100 years, known as the Hopewell Wildfire, resulted in approximately 740 acres of burned woodland as described below. Figure 4-3 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.

The Hopewell Wildfire, which started on April 9, 2012, in southern Berks County, required over 200 firefighters from surrounding municipalities for it to be contained. The Hopewell Wildfire was centered around French Creek State Park and spread to parts of Union Township, Berks County, and North Coventry and Warwick Townships, Chester County. High winds, combined with dry conditions and fuel loading from downed trees from the October 2011 snowstorm, resulted in

perfect conditions for a wildfire that was uncontained for nearly a week. An After Action Review meeting was held on May 2, 2012, at the North Coventry Fire Company. Stakeholders from the United States Forest Service (USFS), PA DCNR, PEMA, local volunteer fire departments, and various other participants that helped contain the wildfire met to discuss the outcome of the fire. The stakeholders acknowledged that communications between the various participants was the greatest challenge. It was noted that eight different radio frequencies were used, and the topography of the site caused communication limitations. In addition, problems with direct oral communication were experienced because group leaders could not be identified due to uniforms lacking identification. High winds prevented an aerial assault on the first day of the fire. Communication with the bulldozer operator was also discussed. Obtaining aerial mapping of the site was also a challenge at the beginning of the fire. Despite the challenges, there were no significant injuries upon containment of the wildfire. Figure 4-4 summarizes the boundary of the wildfire.

N

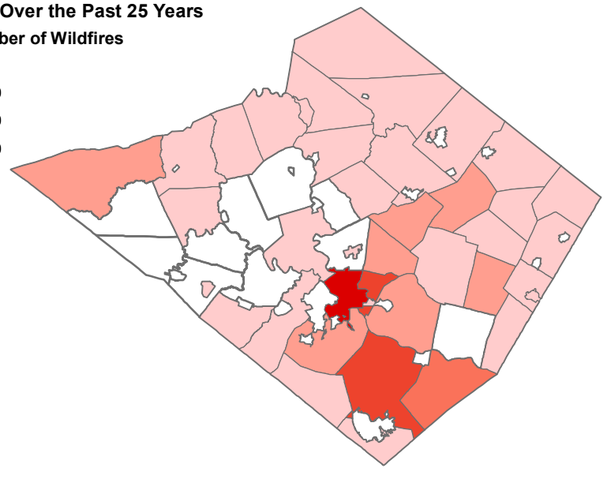
ALBANY
LENHARTSVILLE
WINDSOR
GREENWICH
HAMBURG
TILDEN
UPPER BERN
POTTSVILLE PKE
PERRY
KUTZTOWN
MAXATAWNY
222
183
UPPER TULPEHOCKEN
SHOEMAKERSVILLE
TOPTON
LONGSWAMP
STRAUSSTOWN
BETHEL
CENTERPORT
RICHMOND
LYONS
MAIDENCREEK
CENTRE
FLEETWOOD
ROCKLAND
HEREFORD
JEFFERSON
PENN
LEESPORT
DISTRICT
ONTELAUNEE
RUSCOMBMANOR
100
TULPEHOCKEN
BERNVILLE
BERNVILLE RD
MUHLENBERG
PIKE
BALLY
MARION
NORTH HEIDELBERG
BERN
LAUREL DALE
ALSACE
WASHINGTON
BECHTELSVILLE
OLEY
WOMELSDORF
HEIDELBERG
LOWER HEIDELBERG
LOWER ALSACE
COLEBROOKDALE
READING
EARL
ROBESONIA
BOYERTOWN
WEST READING
MT PENN
ST LAWRENCE
EXETER
WERNERSVILLE
SINKING SPRING
WYOMISSING
DOUGLASS
SOUTH HEIDELBERG
SHILLINGTON
KENHORST
AMITY
SPRING
MOHNTON
CUMRU
422
222
BIRDSBORO
ROBESON
UNION
BRECKNOCK
176
NEW MORGAN
76
CAERNARVON
76

Disclaimer: This map was created for planning purposes only and is not intended for other uses.

Wildfires Over the Past 25 Years

Total Number of Wildfires

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



Legend

- Streams
- State Roads
- Interstates
- US Routes
- Townships
- Forested Area
- Wildland/Urban Interface Structures

SKELLY AND LOY
A ferracon Company

MARCH 2023

Figure 4-3

Berks County Hazard Vulnerability Assessment and Mitigation Plan Update

WILDFIRE HAZARDS

Berks County, Pennsylvania

Job No: JN227087

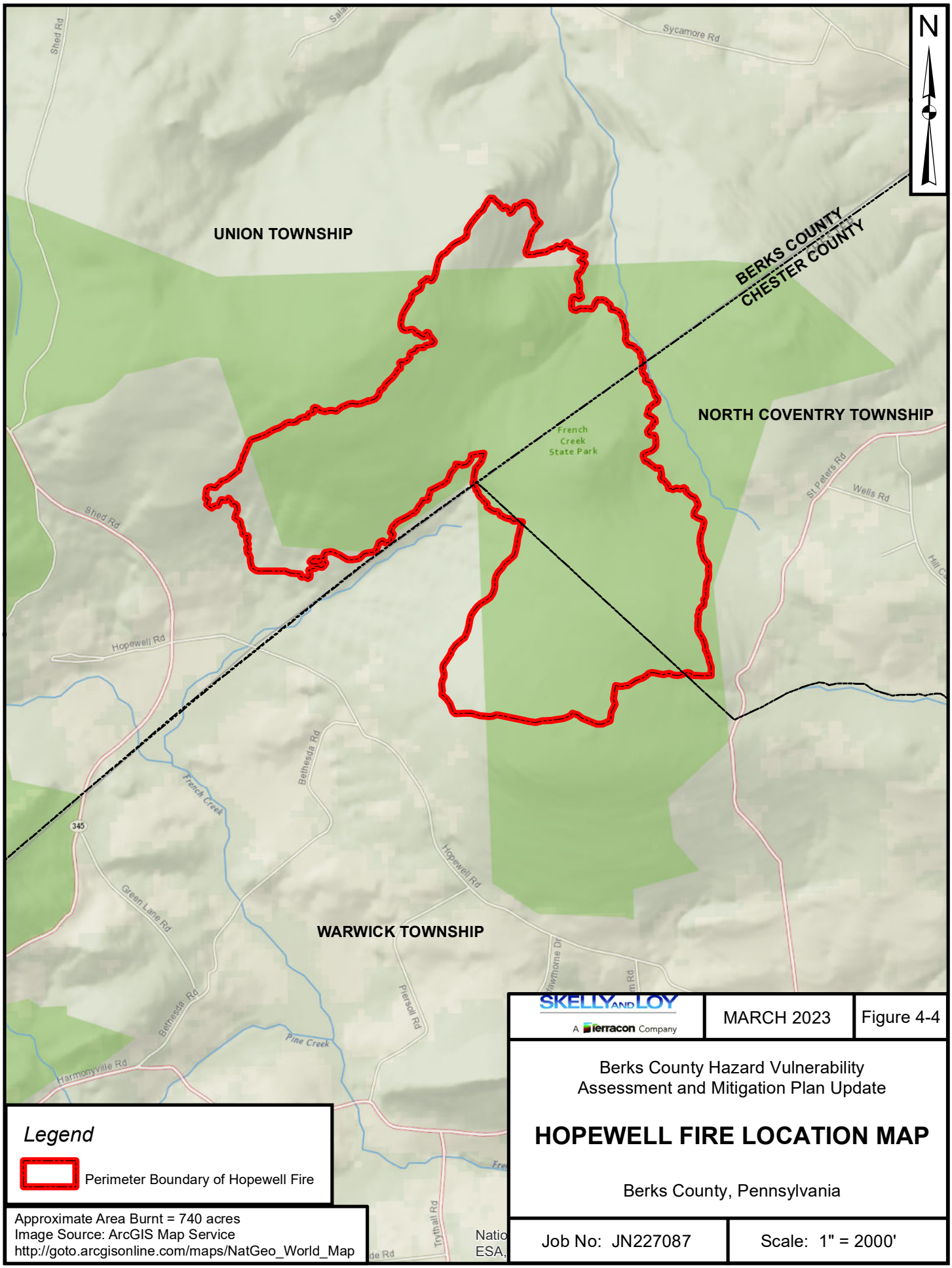
Scale: 1" = 20,000'

A more recent forest fire occurred on November 21, 2016, on Mount Penn in Reading. The fire started above Hampden Park, near Reading High School, and a combination of dry conditions and high winds caused the fire to spread quickly up the mountain. More than 100 firefighters from the region responded, including some from as far away as Pottstown in Montgomery County. More than 50 acres of forest on Mount Penn burned. The PA DCNR Bureau of Forestry declared the fire completely extinguished one week after it began. No injuries or property/structure damages were reported. There were no evacuations needed, and no homes were in danger.

4.3.10.4 Future Occurrence – Wildfires

As discussed above, Berks County has averaged approximately 13 wildfires per year over the past 25 years. On average, these wildfires account for approximately 39 acres of burned area per year, which equates to an estimated average burned area of three acres per fire. For comparison, Pennsylvania experiences approximately 1,000 wildfires every year. The vast majority (90%) of these wildfires are caused by people and could easily be prevented by applying simple, common-sense safety practices when using fire.

There are no indicators that another large wildfire, such as the Hopewell fire, will consume 740 acres of forest. However, as climate changes seem to be occurring more frequently and land use changes occur with more urban development in the Wildland/Urban Interface, the risk of wildfires is not likely to decrease. As part of this Berks County Hazard Mitigation Plan Update, the importance of continued education and public outreach will dictate the severity and frequency of future wildfires. The mitigation provided in this plan will help to alleviate the risk of future wildfires.



Legend

Perimeter Boundary of Hopewell Fire

Approximate Area Burnt = 740 acres
Image Source: ArcGIS Map Service
http://goto.arcgisonline.com/maps/NatGeo_World_Map

SKELLY AND LOY
A Terracon Company

MARCH 2023

Figure 4-4

Berks County Hazard Vulnerability
Assessment and Mitigation Plan Update

HOPEWELL FIRE LOCATION MAP

Berks County, Pennsylvania

Job No: JN227087

Scale: 1" = 2000'

4.3.10.5 Vulnerability Assessment - Wildfires

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 on a 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 (i.e., the Hopewell Wildfire).

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss from wildfires in Berks County was calculated to be $1,893.

4.3.11 Radon

4.3.11.1 Location and Extent - Radon

Radon is a radioactive, colorless, odorless, tasteless gas. Radon can occur in some spring waters, but its greatest hazard is found in concentrations that accumulate in attics and basements of buildings. It is caused by the natural breakdown of uranium that can be found in soil, rocks, and water. Studies have found that breathing high concentrations of radon can cause an increased risk of lung cancer. According to the U.S. EPA, radon is the leading cause of lung cancer, causing 21,000 deaths per year in the United States for non-smokers. The U.S. EPA estimates that 1 in 15 homes in the United States have elevated levels of radon.

Given that radon is a gas, it is often overlooked as a threat to personal well-being. The purchase of a home is usually when residential structures are tested for radon; however, testing should occur periodically. Home test kits for short-term tests are inexpensive and can be completed in only a few minutes. The test kits measure picocuries per liter (pCi/L) of air and can be purchased at a local hardware store. A qualified radon tester could also be hired to conduct a radon test. Long-term radon tests can also be completed to determine a home's yearly average of radon content. The long-term radon test lasts 90 days.

4.3.11.2 Range of Magnitude - Radon

The U.S. Environmental Protection Agency (EPA) has designated three zones (1, 2, and 3) for potential exposure to radon. Review of the EPAs website and Pennsylvania 2018 All-Hazard Mitigation Plan indicates all of Berks County is located within Zone 1 for high radon potential. Counties located within the high radon potential zone have a predicted average indoor radon screening of greater than 4 pCi/L. According to PA DEP, 54% of Berks County homes have radon levels greater than 4 pCi/L. Appendix I illustrates the radon hazard levels within Berks County

EPA recommends mitigation for structures with radon test results greater than 4 (pCi/L). If the radon tests results are less than 4 pCi/L, then the PA DEP Bureau of Radiation Protection, Radon Division recommends radon testing in both residential structures and commercial structures every two years. PA DEP also recommends radon testing upon completion of any structural alterations to the residential or commercial property. Table 4-12 shows how increased radon levels can affect people.

TABLE 4-15
RADON RISK FOR SMOKERS AND NON-SMOKERS

Radon Level (PCI/L)	If 1,000 people were exposed to this level over a lifetime …	Risk of cancer from radon exposure compares to …	Action threshold
Smokers			
20	About 260 people could get lung cancer	250 times the risk of drowning	Fix structure
10	About 150 people could get lung cancer	200 times the risk of dying in a home fire	Fix structure
8	About 120 people could get lung cancer	30 times the risk of dying in a fall	Fix structure
4	About 62 people could get lung cancer	5 times the risk of dying in a car crash	Fix structure
2	About 32 people could get lung cancer	6 times the risk of dying from poison	Consider fixing between 2 and 4 pCi/L
1.3	About 20 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/L is difficult
0.4		(Average outdoor radon level)	
Non-smokers			
20	About 36 people could get lung cancer	35 times the risk of drowning	Fix structure
10	About 18 people could get lung cancer	20 times the risk of dying in a home fire	Fix structure
8	About 15 people could get lung cancer	4 times the risk of dying in a fall	Fix structure

4	About 7 people could get lung cancer	The risk of dying in a car crash	Fix structure
2	About 4 people could get lung cancer	The risk of dying from poison	Consider fixing between 2 and 4 pCi/L
1.3	About 2 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/L is difficult
0.4		(Average outdoor radon level)	

4.3.11.3 Past Occurrence – Radon

The EPA has estimated that the average indoor radon concentration in Pennsylvania basements is about 7.1 pCi/L and 3.6 pCi/L on the first floor (PADEP, 2019). The PA DEP Bureau of Radiation Protection collects data on the number of tests reported and their results. A review of the results finds that the radon levels in Berks County can range from 5 to 13 (pCi/L) in the basement and 2 to 8 (pCi/L) on the first floor.

4.3.11.4 Future Occurrence - Radon

As stated above, radon is a radioactive, colorless, odorless, tasteless gas. Radon can occur in some spring waters, but its greatest hazard is found in concentrations that accumulate in attics and basements of buildings. It is caused by the natural breakdown of uranium that can be found in soil, rocks, and water. Studies have found that breathing high concentrations of radon can cause an increased risk of lung cancer.

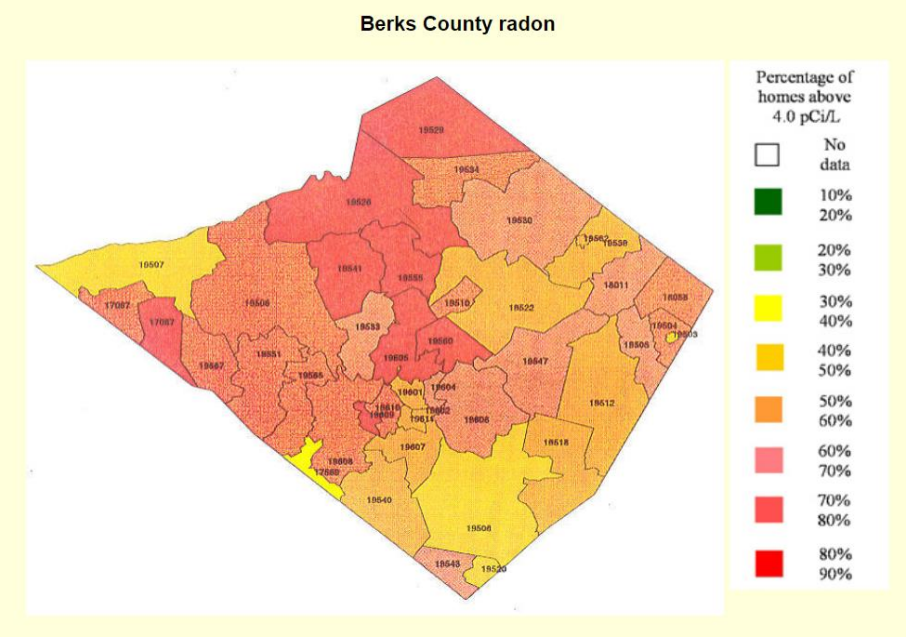
According to PA DEP, 54% of Berks County homes have radon levels greater than 4 pCi/L. Appendix K illustrates the radon hazard levels within Berks County. Review of EPA's website and the Pennsylvania 2018 All-Hazard Mitigation Plan indicates all of Berks County is located within Zone 1 for high radon potential. Counties located within the high radon potential zone have a predicted average indoor radon screening of greater than 4 pCi/L.

Future occurrences of radon can be managed by testing structures at the time of purchase to inform new homeowners of the radon levels and to ensure mitigation is completed. Similarly, there are radon-resistant construction techniques that can be employed in new construction including a gravel layer below the concrete slab to add an air flow layer. Adding plastic sheeting to

the top of the gravel layer and caulking cracks can prevent gases from entering the house. Finally adding a vent pipe and fan is the most effective mitigation.

4.3.11.5 Vulnerability Assessment - Radon

Given the colorless, odorless, and tasteless gas that is radon, individuals will continue to ignore warnings and testing requirements as it is an “out of sight, out of mind” type of hazard. It is unlikely the effect of radon will decrease over time given the increased rates of residential construction in Berks County and the fact that effects do not occur in short time periods (i.e., less than a year). Public education and construction requirements especially in the central and northern portions of the county, as illustrated by the EPAs Radon Exposure by Zip Code map below, are critical to reducing the threat. Steps could be taken to test and mitigate radon exposure in public buildings, more stringent requirements when selling a house, education for not only the public at large but also underserved populations and health care providers.



EPA Radon Exposure by Zip Code for Berks County

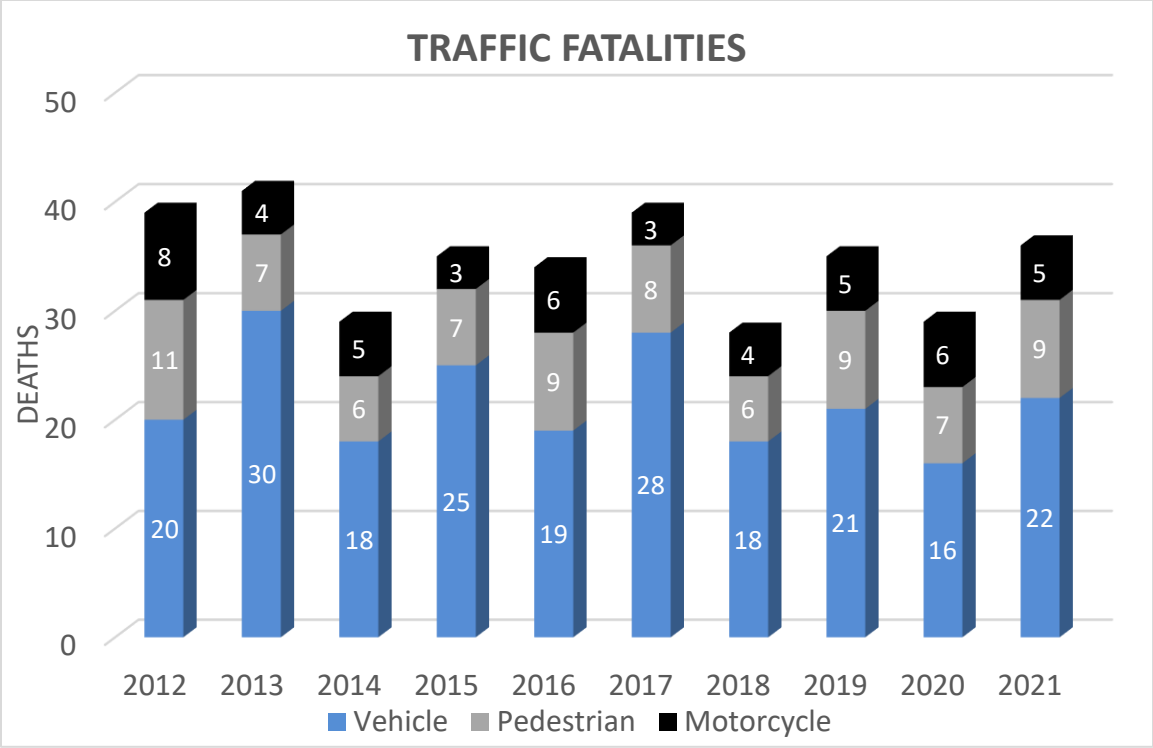
4.3.12 Technological Hazards

4.3.12.1 Location and Extent – Technological Hazards

Technological hazards and cyber-attacks originate from technological or industrial accidents, dangerous procedures, infrastructure failures, or specific human activities that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Technological hazards and cyber-attacks have no boundaries and can affect any part of the County at any time.

In 2007 Berks County identified several hazards that fit into this category, such as nuclear radiation associated with the Limerick Nuclear Generating Station, dam failures (Hazard Event Profile 4.3.1) and inundation areas for five of the County's high-hazard dams, and terrorism. Technological Hazards was added to the 2018 Hazard Mitigation Plan to encompass a broader range of existing hazards not uncommon to Pennsylvania or Berks County. Transportation emergencies or incidents affecting infrastructure are common and relatable technical hazards. From January 1, 2017, to November 2, 2022, Berks County experienced 393 reported incidents related to transportation and infrastructure (see the chart below for accidents with fatalities).

Large volumes of hazardous materials are transported through Berks County by highway, rail, and pipeline. The most serious transportation concern involves various highway routes throughout the County. The greatest risk and most challenging of these highways is Interstate 78 due to the limited access. Interstates 78 and 176 contribute to long backlogs and the potential for additional accidents, with exits in sparsely populated areas. These roadways are inadequate to handle large volumes of commercial traffic.



PennDOT Reportable Crash Fatality Statistics

Cyber security attacks respect no boundaries. Victims and perpetrators can be anywhere on the globe as long as they are connected to the Internet. Though many of the cyberattacks are initiated by criminals seeking to make money through some scheme, hackers with no criminal intent may create attacks for the intellectual thrill of it. Also, attacks to cyber security may be initiated as part of a terrorist action or other form of protest. In all cases, they are criminal acts that can result in significant damage or theft of money or identity. Significant damage to any computer systems with access to the Internet can be initiated by remote sources that intrude into operating systems to erase data, extract data, manipulate data, implant malicious software codes that further control operating system functions, or destroy the operating system and associated software. Attacks come in various forms and respect no boundaries, originating from anywhere in the world. Even attacks that do not penetrate a computer's operating system can cause disruptions if multiple service requests sent to a victim's computer overwhelms the system, causing it to freeze, reboot, and ultimately not able to carry out regular tasks. Other forms of attacks involve various deceptive schemes or social engineering which induce people to do things they would not do ordinarily.

4.3.12.2 Range of Magnitude – Technological Hazards

As more business is transacted through the Internet and more people rely on Internet access, the potential for cyber disruption becomes more of a concern. Cyber security incidents may include, but are not limited to, the following events (regardless of platform or computing environment).

- Unauthorized access to a network, system, and/or data
- Repeated attempts at unauthorized access (from either internal or external sources)
- System changes not authorized by nor known to the system owner
- Denial of Service (DoS) attack or other disruptions to service
- Evidence of tampering with, removal of, or loss of data
- Website defacement
- Social engineering incidents
- Theft of, or non-accidental physical damage to, information systems
- Malware attacks adversely affecting servers or workstations

Since the development of the Internet, various forms of disruptive attacks have been made for a variety of reasons. Initially, many of attacks appeared to result from an odd sense of intellectual curiosity in which hackers were trying to outwit new forms of technology for shear thrill. As the economic power of the Internet became evident, more attacks were initiated to steal money and information. Today, Internet crime is a billion-dollar enterprise operating at all points of the globe.

Large-scale cyber incidents may overwhelm government and private-sector resources by disrupting the Internet and/or taxing community lifelines. In most cases, temporary disruption and inconvenience may be the result. Community lifelines include safety and security; food, water, shelter; health and medical; energy; communications; transportation; and hazardous materials.

Significant attacks may threaten lives, property, the economy, and national security. For example, the loss of computer control on various mechanical and environmental systems could lead to system failures and potential pollution threat. More critically, the loss of computer support for critical security, defense, or medical systems could result in injury or death.

4.3.12.3 Past Occurrences – Technological Hazards

Cyber-attacks can include a wide range of threats like card skimming, pharming, phishing, spam, spoofing, or a virus. Notable past attacks in Berks County include a ransomware attack on the Fleetwood Area School District in 2022 and a cyber-attack on the Leesport Tax Collector in 2019. While these are just a few examples of past attacks, phishing and card skimming attacks are happening daily and many are not reported. Government, education, and medical institutions are most at risk for a large-scale, well-thought-out attacks.

4.3.12.4 Future Occurrences – Technological Hazards

As documented as part of the Hazard Mitigation Plan, technological hazards are on the rise across Berks County and beyond. Computer hacking crimes have increased through cyber-hacking and other related cybercrimes. While technology advances, so does the security required to maintain computer operating systems within the local governments of Berks County.

On a larger scale, traffic-related incidents are on the rise in Berks County as motorists travel through the Keystone State to and from New York City and the New England states. As of 2021, over 45,000 vehicles travel across I-78 through Berks County on a daily basis. Significantly high amounts of truck traffic (30%, or 13,500 trucks) travel along I-78 through Berks County on a daily basis; therefore, the potential for severe accidents has continued to increase. Some of these trucks haul hazardous material, such as petroleum products, while the rest is shipped in trains and pipelines. Increased construction of warehouses and inexperienced truck drivers continue to demonstrate their lack of driving skills, as evidenced by the accidents that result in road closures.

Future cyberattacks can be avoided only by continuing to upgrade antivirus software and firewalls to prevent viruses. Traffic accidents cannot be prevented due to human nature and increased traffic speeds with only minor improvements to the transportation infrastructure. Increased digital message boards to communicate with motorists is defined mitigation that seems to work well related to weather and stopped traffic ahead. Other mitigation opportunities will continue to be explored to reduce technological hazards.

The Berks County Intermediate Unit has curated a list of resources for school district administrators in creating awareness, assessing current practices, and taking action on cybersecurity.

4.3.12.5 Vulnerability Assessment – Technological Hazards

Cyber-threats are real for not only individuals but also large institutions within the County. There is no way to completely avoid a cyber-attack or technological attack; however, there are way to mitigate these threats including the following:

- Create a cybersecurity policy
- Require multifactor authentication
- Update and upgrade software regularly
- Install firewalls
- Backup data regularly
- Control system access and wifi security
- Regular employee training
- Strong and complex passwords

4.3.13 Pandemics

4.3.13.1 Location and Extent – Pandemics

Pandemic is defined as a disease affecting or attacking the population of an extensive region, including several countries, and/or continents. It is further described as an extensive epidemic. Generally, pandemic diseases cause sudden, pervasive illness in all age groups on a global scale. Infectious diseases are highly virulent and spread person-to-person. Pandemics are a widespread hazard that affect the entire county.

4.3.13.2 Range of Magnitude – Pandemics

The range and magnitude of a pandemic depends on many factors including rate of transmission, transmission mode, and population density. A widespread pandemic or infectious event could affect the entire County, spreading faster in more populated areas or within populations at higher risk (i.e., nursing homes and hospitals).

4.3.13.3 Past Occurrences – Pandemics

There have been five recorded pandemics in the United States and Berks County since the early 1900s. The Spanish Flu (1918-1919) was the most severe pandemic in recent history. Caused by the H1N1 virus with genes of an avian origin, it spread worldwide, and it is estimated that about 500 million people or one-third of the world's population became infected. Deaths were estimated to be at least 50 million worldwide with about 675,000 occurring in the United States. In 1957 the Asian Flu (H2N2) emerged in East Asia triggering a pandemic. The estimated number of deaths was 1.1 million worldwide and 116,000 in the United States. In 1968 the Hong Kong Flu (H3N2) spread worldwide. The estimated number of deaths was 1 million worldwide and about 100,000 in the United States. Most deaths were in people 65 years and older. The H3N2 virus continues to circulate worldwide as a seasonal influenza A virus. In the spring of 2009, a novel influenza A (H1N1) virus, identified as the Swine Flu, emerged. It was first detected in the United States and spread quickly across the United States and the world. This new H1N1 virus contained a unique combination of influenza and genes not previously identified in animals or people. This virus was very different from H1N1 viruses that were circulating at the time of the pandemic. Few young people had any existing immunity to the H1N1 virus, but nearly one-third of people over 60 years old had antibodies against this virus, likely from exposure to an older H1N1 virus earlier in their lives. The Centers for Disease Control (CDC) estimated that there were 60.8 million cases, 274,304 hospitalizations, and 12,469 deaths in the United States.

The COVID-19 pandemic, also known as the coronavirus pandemic, is an ongoing global pandemic of coronavirus disease caused by severe acute respiratory syndrome coronavirus A (SARS-COV-2). The novel virus was first identified from an outbreak in Wuhan, China, in December 2019. Attempts to contain it failed, allowing the virus to spread to other areas of China and later worldwide. The World Health Organization (WHO) declared the outbreak a public health emergency of international concern on January 30, 2020, and a pandemic on March 11, 2020. As of September 2022, the pandemic has caused more than 612 million cases and 6.52 million confirmed deaths, making it one of the deadliest in history. COVID-19 cases in Berks County as of October 2022 were 117,000 with 1,667 deaths since the start of the pandemic in the United States in March 2020. Total cases in Pennsylvania since the start of the pandemic were 3.25 million, and total deaths were 47,213. The COVID-19 pandemic has triggered severe social and economic disruption around the world, including the largest global recession since the Great Depression. COVID-19 vaccines have been approved and widely distributed in various countries

since December 2020. Other recommended preventive measures include social distancing, wearing masks, improving ventilation and air filtration, and quarantining those who have been exposed or are symptomatic. Treatments include monoclonal antibodies, novel antiviral drugs, and symptom control. Governmental interventions include travel restrictions, lockdowns, business restrictions and closures, workplace hazard controls, quarantines, testing systems, and tracing contacts of the infected. These governmental interventions have been implemented at the state level in Pennsylvania and most of the United States.

4.3.13.4 Future Occurrences – Pandemics

Future occurrences of pandemics are difficult and almost impossible to predict. They typically occur when the influenza Type A virus makes a change, or antigenic shift, that results in a new virus to which the population has no immunity. Future pandemics may also emerge from other diseases, especially invasive pathogens that Pennsylvanians do not have natural immunity to. Given the past occurrences, it is possible for a pandemic to occur at any time and the County should expect and be ready for an event that would affect the entire County. Pandemics cannot be prevented by the County, but the County's response and preparedness can aid in reducing the effect on its residents.

4.3.13.5 Vulnerability Assessment – Pandemics

Some facilities and populations are more vulnerable than others in the County; however, recent experiences with COVID-19 have provided a social awareness and best practices that can be accessed quickly. Preventative measures such as wearing masks, travel restrictions, social distancing, and quarantining have become simple tools available for use should the County face another pandemic or infectious disease event.

4.4 HAZARD VULNERABILITY SUMMARY

4.4.1 Methodology

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.

The first task of the asset identification focused on the identification and mapping of community lifelines 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; 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:

1. buildings or locations vital to the hazard response effort (i.e., Emergency Operations Centers [EOCs], police, fire and EMS stations, hospitals/mass care centers, evacuation centers/emergency shelters, communications facilities, schools, etc.); and

2. 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 (updated September 2022), 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 4-13 lists the total number of vulnerable structures and vulnerable critical facilities by municipality for the profiled hazard event. Information reported in Table 4-13 was used to estimate potential losses from the profiled hazard events.

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 Wernersville State Hospital in South Heidelberg Township.

In regard to the future development of additional critical facilities, the BCPC indicated in the Berks County Comprehensive Plan “Berks County Comprehensive Plan 2030 Update” that the County is expected to experience continued growth over the next 12 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 Mitigation 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.

TABLE 4-16
BERKS COUNTY ASSET VULNERABILITY BY MUNICIPALITY

MUNICIPALITY	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
Albany Township	114	0	0	0	0	0	80	1
Alsace Township	21	0	193	0	60	0	183	0
Amity Township	210	1	728	1	580	1	660	0
Bally Borough	0	0	179	0	2	0	0	0
Bechtelsville Borough	158	3	372	3	45	0	19	0
Bern Township	74	0	1,278	11	0	0	140	1
Bernville Borough	46	4	0	0	0	0	7	0
Bethel Township	50	0	13	0	0	0	265	0
Birdsboro Borough	180	5	0	0	387	1	135	0
Boyertown Borough	2	0	206	1	76	1	1	0
Brecknock Township	36	2	0	0	43	0	351	1
Caernarvon Township	24	0	989	5	149	0	224	0
Centerport Borough	9	0	0	0	0	0	0	0
Centre Township	102	0	185	1	0	0	87	0
Colebrookdale Township	115	3	453	0	161	0	143	0
Cumru Township	168	1	2,304	10	233	4	619	4

TABLE 4-16
(CONTINUED)

MUNICIPALITY	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
District Township	11	0	11	0	67	0	107	0
Douglass Township	171	0	189	0	296	1	84	0
Earl Township	60	0	492	0	66	0	227	0
Exeter Township	434	2	4,232	12	1,303	1	1,273	1
Fleetwood Borough	19	0	2,150	15	0	0	10	0
Greenwich Township	154	0	0	0	0	0	116	0
Hamburg Borough	366	3	0	0	0	0	13	0
Heidelberg Township	37	0	510	2	1	0	86	0
Hereford Township	97	1	103	1	103	0	313	0
Jefferson Township	24	0	44	0	0	0	71	0
Kenhorst Borough	31	0	1,748	3	0	0	0	0
Kutztown Borough	174	3	2,105	12	0	0	1	0
Laureldale Borough	0	0	1,288	9	0	0	0	0
Leesport Borough	115	3	719	5	0	0	45	0
Lenhartsville Borough	16	0	0	0	0	0	2	0
Longswamp Township	79	0	1,164	7	24	0	170	0

TABLE 4-16
(CONTINUED)

MUNICIPALITY	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
Lower Alsace Township	134	2	2,032	6	70	0	45	0
Lower Heidelberg Township	57	0	1,097	0	0	0	133	0
Lyons Borough	0	0	285	5	0	0	0	0
Maidencreek Township	63	0	3,653	6	0	0	159	0
Marion Township	47	0	594	4	0	0	15	0
Maxatawny Township	240	0	1,395	12	0	0	32	0
Mohnton Borough	50	0	0	0	24	0	136	0
Mt Penn Borough	0	0	1,658	7	0	0	15	0
Muhlenberg Township	725	1	9,216	21	17	0	273	1
New Morgan Borough	0	1	0	0	13	0	8	1
North Heidelberg Township	33	0	110	2	0	0	46	0
Oley Township	208	0	1,108	4	23	0	36	0
Ontelaunee Township	200	1	570	7	0	0	22	0
Penn Township	20	0	134	0	0	0	33	0
Perry Township	195	0	53	0	0	0	34	0

TABLE 4-16
(CONTINUED)

MUNICIPALITY	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
Pike Township	86	0	209	0	33	0	152	0
Reading City	693	16	41,642	84	38	0	64	0
Richmond Township	126	0	1,113	9	0	0	77	1
Robeson Township	333	2	6	0	266	1	511	1
Robesonia Borough	39	0	1,082	8	0	0	13	0
Rockland Township	31	0	86	0	36	0	375	1
Ruscombmanor Township	20	0	99	0	21	0	314	0
Shillington Borough	18	1	2,949	10	0	0	2	0
Shoemakersville Borough	127	1	0	0	0	0	4	0
Sinking Spring Borough	38	0	1,774	4	0	0	123	0
South Heidelberg Township	81	1	1,966	5	139	0	218	0
Spring Township	135	3	10,340	30	81	0	707	1
St. Lawrence Borough	22	0	755	4	0	0	31	0
Tilden Township	73	0	0	0	0	0	55	0
Topton Borough	19	0	1,053	5	0	0	4	0
Tulpehocken Township	20	0	71	0	0	0	52	0

TABLE 4-16
(CONTINUED)

MUNICIPALITY	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
Union Township	227	2	0	0	200	3	154	0
Upper Bern Township	13	0	0	0	0	0	71	1
Upper Tulpehocken Township	11	0	0	0	0	0	68	0
Washington Township	124	0	530	4	114	0	275	0
Wernersville Borough	4	0	1,185	7	0	0	1	0
West Reading Borough	29	1	2,537	10	0	0	0	0
Windsor Township	38	2	0	0	0	0	39	0
Womelsdorf Borough	10	0	1,303	6	0	0	24	0
Wyomissing Borough	33	1	4,290	17	0	0	25	0
Total*	**7,419**	**66**	**116,550**	**375**	**4,671**	**13**	**9,781**	**15**

* Total number of vulnerable structures is based on the 2022 100-year FEMA Floodplain data. The total number of vulnerable critical facilities is based on December 2022 Berks County GIS data.

FEMA developed the term “Community Lifelines” which includes fundamental services in the community. Community Lifelines include safety, security, food, water, shelter, health and medical, energy, communications, transportation, and hazardous materials. Efforts to protect lifelines, prevent and mitigate potential impacts to them, and build back stronger and smarter during recovery will drive overall resilience when hazards occur.

4.4.2 Ranking Results

Ranking hazards aids communities in setting goals and priorities for mitigation based on their vulnerabilities. A risk factor (RF) is a tool used to measure the degree of risk for identified hazards in a particular planning area. The RF can also assist local community officials in ranking and prioritizing hazards that pose the most significant threat to a planning area based on a variety of factors deemed important by the planning team and other stakeholders involved in the hazard mitigation planning process.

4.4.3 Potential Loss Estimates

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 conducted for the asset identification and reported in Table 4-6 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.

TABLE 4-17
BERKS COUNTY HAZARD RISK ASSESSMENT MATRIX

FREQUENCY		IMPACT
Annual Event	5	Catastrophic
Every 5 Years or less	4	Extensive
Every 10 Years or less	3	High
Every 30 Years or less	2	Moderate
Greater than 30 Years	1	Low

Risk Factor =
Frequency x (.25 x (Critical Facilities)
+ .40 x (Social) + .25 x (Economic) + .10 x (Environmental))

RISK FACTOR INDEX	
.2500 - 6.00	Acceptable without review
6.10 - 12.00	Acceptable with review
12.10 - 18.00	Undesirable
18.10 - 25.00	Unacceptable

HAZARD	FREQUENCY OF OCCURRENCE AND LOCATION		IMPACT: CRITICAL FACILITIES (25% VULNERABILITY)	IMPACT: SOCIAL (40% VULNERABILITY)	IMPACT: ECONOMIC (25% VULNERABILITY)	IMPACT: ENVIRONMENTAL (10% VULNERABILITY)	RISK FACTOR	VULNERABILITY: (A) HEALTH AND SAFETY OF PERSONS IN THE AFFECTED AREA AT THE TIME OF THE INCIDENT (INJURY AND DEATH)	VULNERABILITY: (B) HEALTH AND SAFETY OF ESSENTIAL PERSONNEL	VULNERABILITY: (C) CONTINUITY OF GOVERNMENT	VULNERABILITY: (D) PROPERTY, FACILITIES, AND INFRASTRUCTURE	VULNERABILITY: (E) DELIVERY OF SERVICES	VULNERABILITY: (F) THE ENVIRONMENT	VULNERABILITY: (G) ECONOMIC AND FINANCIAL CONDITION
Civil Disorder - Vulnerabilities and impacts are contingent upon numerous factors including issues, politics, and method of response. Some type of civil disorder occurs every day with minimal impact.	2	Small events occur frequently; however, larger events are not as common.	1	1	1	1	2.000	Nominal impact to the health and safety of people in the affected area	Nominal impact to first responders; minor injury from missiles and physical confrontations	Nominal and short-term impact on continuity of county government operations	Impact on property, facilities, and infrastructure will likely result from acts of vandalism and will be nominal in scope	Nominal impact on the delivery of services resulting from work stoppages	Limited environmental impact unless acts of sabotage are performed	Economic and financial impact to the community will be nominal
Cyber Security/Attacks - Vulnerabilities and impacts are dependent on the theft or damage to hardware, software, and to information on them as well as from disruption or misdirection of the services they provide. Malicious code to alter computer code, logic, or data, resulting in disruptive consequences that can compromise data and lead to cybercrimes such as information and identity theft.	5	The cost of cyberattacks is increasing annually; the occurrence and sophistication of such attacks also are on the rise.	3	2	3	1	12.000	Low impact on health and safety	Low to moderate impact to first responders; redundancy in systems reduces the impact but will not eliminate the threat	Low to moderate impact on continuity of government operations if computer systems are restored in a reasonable amount of time and depends on what systems are affected; critical to have current and updated malware and firewalls in place	Low to moderate impact to property, facilities, and infrastructure; business and industry may suffer financial losses, inventory control, ability to pay employees, billing, and meeting the needs of consumers	Moderate disruption of basic life support systems; typically of short duration	Low impact to environment unless control of critical systems is taken over with malicious intent	Economic and financial impact to the community can range from nominal to catastrophic and will be contingent upon the type of attack or security breach for an extended period of time
Dam Failure - Vulnerabilities and impacts are dependent on the type of release (whether gradual or catastrophic), volume released, its impact to the environment, and meteorology.	5	With 123 dams (including 30 high-hazard dams) in Berks County, there have been no major failures that caused loss of life or significant property damage. Small dam failures occur annually with little impact.	1	2	2	1	8.250	Generally low impact on health and safety; however, catastrophic, unannounced breach of a high-hazard dam could result in a substantial number of deaths and injuries	Low impact to first responders; primary threat comes from debris and possible hazardous materials contamination	Low impact on continuity of government operations unless located in the inundation curve	Vital lifelines (roads, gas and water pipelines) may be damaged as a result of released waters	Moderate impact on the delivery of services to the affected area	Limited environmental impact that is contingent upon the nature of the inundation area; urban environments will have a higher potential to release hazardous materials	Impact is contingent upon the nature of the event
Drought - Vulnerability and impacts are contingent upon the duration of the drought period and area of impact.	3	Berks County has experienced many droughts. The County has also seen its share of unseasonably dry weather. These events are known to cause wildfires and water shortages.	1	2	2	2	5.250	Limited impact; severe drought conditions may require water rationing and distribution to affected communities	N/A	Low impact to government; prolonged drought periods may require suspension of services such as public schools	Low impact to property, facilities, and infrastructure; water utilities may lose pressure; hydroelectric power generation could suffer	Low impact to the delivery of services; hospitals may be required to make use of alternate water supplies	Low impact; reduction to groundwater supplies creates situations conducive to sinkholes; non-domestic animals may be impacted	Long-term water shortages will have a high impact on agribusiness, public utilities, and other industries reliant on water for production (i.e., plastics) or services (i.e., landscaping)

TABLE 4-17
(CONTINUED)

HAZARD		FREQUENCY OF OCCURRENCE AND LOCATION	IMPACT				RISK FACTOR	VULNERABILITY						
			CRITICAL FACILITIES (25% VULNERABILITY	SOCIAL (40% VULNERABILITY	ECONOMIC (25% VULNERABILITY	ENVIRONMENTAL (10% VULNERABILITY		(A) HEALTH AND SAFETY OF PERSONS IN THE AFFECTED AREA AT THE TIME OF THE INCIDENT (INJURY AND DEATH)	(B) HEALTH AND SAFETY OF ESSENTIAL PERSONNEL	(C) CONTINUITY OF GOVERNMENT	(D) PROPERTY, FACILITIES, AND INFRASTRUCTURE	(E) DELIVERY OF SERVICES	(F) THE ENVIRONMENT	(G) ECONOMIC AND FINANCIAL CONDITION
Earthquake - Vulnerabilities and impacts are contingent upon numerous factors including geographic location, magnitude, and method of response. The earth is dynamic, and some earthquake events occur every day with minimal impact.	3	Earthquakes are a frequent occurrence but are generally not felt. From 1906 to 1996, eight earthquake epicenters were located in Berks County.	1	1	1	1	3.000	Low impact exists for fatalities and injuries; area of impact is generally small	Moderate impact; actions required to protect responders from fire hazards and environmental concerns	Low impact; unlikely to cause relocation of government operations	Low impact to the transportation infrastructure, structures burned, and displaced populations	Low impact to the delivery of services; services likely to be temporarily interrupted in the area of impact	Low impact to area of operations, including animal life, due to limited extent of hazards	Low impact to the economic and financial community; primary impact will be to the repair or replacement of structures in the area of operations
Flooding - Vulnerabilities and impacts are dependent upon the type and location of flooding.	5	Flooding occurs every year in Berks County. Berks County has experienced 59 flood events since 1993. Floods are caused by a variety of factors; the most significant cause is heavy rain.	2	3	3	2	13.250	High impact; potential for loss of life and injuries, especially in urbanized areas prone to flash flooding	Potentially high impact to first responders involved in swift water rescue activities; actions required to protect responders from hazards and environmental concerns	Low impact; unlikely to cause relocation of government operations	Moderate impact; utility outages, transportation infrastructure closures, and isolated populations; varying levels of damage to structures, particularly mobile homes	Moderate disruption of basic life support systems; typically of short duration	Environmental impact should be limited to the release of hazardous substances	Depending on scope and magnitude of flooding, long-term economic disruption is possible, especially among small businesses
Hazardous Materials - Vulnerabilities and impacts are dependent on the type of chemical, volume released, impact to the environment, and meteorology.	5	According to the National Response Center, Berks County has experienced 347 hazardous material spills since 1990.	1	2	1	2	7.500	High impact to health and safety of people living in the impact area	Actions required to protect responders from hazardous materials exposure	Low impact to continuity of operations	Moderate impact to property, facilities, and infrastructure	Low impact to delivery of services	Moderate impact to the areas of highest concentration	Low impact to economic and financial community of the impacted area
Hurricane/Tropical Storms - Vulnerability and impacts a factor of storm strength and area of impact.	5	Berks County has witnessed many hurricanes and tropical storms that often result in property damage or flooding.	2	3	3	1	12.750	High impact; potential for large numbers of injuries and loss of life	Actions required to protect responders from hazards and environmental concerns	Moderate impact; impacted local government operations required to activate their COG Plans	High impact; numerous failures in electrical and other community lifelines	High impact on affected area; widespread disruptions in basic life support services	Some hazardous material releases will occur	Moderate impact; short- and long-term disruption of local economy; statewide impacts on government services unlikely
Landslides - Vulnerabilities and impacts are contingent upon numerous factors including geographic location and nature of the slope failure.	2	PennDOT estimates that it spends $10 million annually on repair contracts for roadways damaged by landslides throughout the Commonwealth. Landslides are not common in Berks County.	1	1	1	1	2.000	Nominal impact to the health and safety of people in the affected area unless the landslide is both sudden and catastrophic	Nominal impact to first responders	Little or no impact on continuity of government operations	Vital lifelines (roads, gas, and water pipelines) may be cut as a result of landslides	Limited impact on delivery of services	Limited environmental impact unless the landslide shears pipelines or damages hazardous material storage facilities (above- or below-ground tanks, etc.)	Limited economic and financial impact to the community unless road networks are extensively damaged
Nuclear Power Plant - Vulnerabilities and impacts are contingent upon the type of radiation released, duration of release, direction and speed of winds, and volume of release.	1	Pennsylvania is home to Three Mile Island (TMI), the only nuclear power plant in the United States to reach the emergency classification level of General Emergency. Since then, significant improvements have been made regarding plant safety.	2	3	3	4	2.850	Potential for significant impact to the health and safety of residing in the 10-mile emergency planning zone or 50-mile ingestion pathway zone	Potential for significant impact; protective actions and special equipment are required to protect responders from radiation exposure	Low impact to continuity of operations, depending on the location of the incident; a design basis accident at TMI would have a catastrophic impact on state government operations	Potentially catastrophic impact to property, facilities, and infrastructure resulting from radionuclide contamination	Potentially high impact on delivery of services in and to the affected area	High impact to the areas of highest concentration of radiological particulates	High impact to economic and financial community of the impacted area; potentially catastrophic impact on agribusiness resulting from radionuclide ingestion and product embargoing
Power Failure - Vulnerabilities and impacts are contingent upon numerous factors including time of year, population density, scope of outage area, and duration of the event.	5	Power failures occur every year, although generally with minimal impact. Widespread power failures occur with unusual weather events.	2	2	2	1	9.500	Generally low impact on health and safety; however, long-term outages during extremely hot or cold weather can have secondary health consequences	Nominal impact to first responders	Low impact on continuity of government operations if emergency backup power sources are available	Limited impact on property or infrastructure	Prolonged outages may result in disruption of water/sewage treatment operations	Environmental impact should be limited to the release of hazardous substances	Protracted outages could result in substantial disruption of commerce and financial activities as well as loss of revenue

TABLE 4-17
(CONTINUED)

HAZARD	FREQUENCY OF OCCURRENCE AND LOCATION		IMPACT				RISK FACTOR	VULNERABILITY						
			CRITICAL FACILITIES (25% VULNERABILITY	SOCIAL (40% VULNERABILITY	ECONOMIC (25% VULNERABILITY	ENVIRONMENTAL (10% VULNERABILITY		(A) HEALTH AND SAFETY OF PERSONS IN THE AFFECTED AREA AT THE TIME OF THE INCIDENT (INJURY AND DEATH)	(B) HEALTH AND SAFETY OF ESSENTIAL PERSONNEL	(C) CONTINUITY OF GOVERNMENT	(D) PROPERTY, FACILITIES, AND INFRASTRUCTURE	(E) DELIVERY OF SERVICES	(F) THE ENVIRONMENT	(G) ECONOMIC AND FINANCIAL CONDITION
Public Health Emergency - Communal and noncommunal diseases.	3	A 1986 Avian Bird Flu outbreak in Schuylkill, Northumberland, and Snyder counties led to the killing of around 307,000 chickens and turkeys, costing the Commonwealth an estimated $650,000.	1	3	3	1	6.900	Potential for significant impact on the general population	Potential for significant impact on essential personnel; however, with precaution, low impact is expected	Low impact on continuity of government	Potential for high impact on property, facilities, and infrastructure, including points of dispensing for Strategic National Stockpile pharmaceuticals	Low impact on delivery of services	Low impact on the environment unless an outbreak or public health emergency reaches animal populations and requires culling	A large outbreak could have a high impact on the economy of the County
Radon - Berks County is located in Pennsylvania's highest risk area for radon and radon product emissions.	5	No home is considered safe from radon until tested. In the first two years of radon testing in Pennsylvania, approximately 59% of all homes tested were found to be contaminated by radon and radon products.	1	3	1	2	9.500	Over time, impact can be severe; excessive exposure to radon is a known cause of lung cancer	Low impact to first responders; primary threat comes exposure over an extended period of time	Low impact on continuity of government	Low physical impact on property and facilities; however, untreated high radon levels can greatly lessen property values	Low impact on delivery of services	Radon can have a high impact on the environment if untreated	Low impact unless high levels of radon are detected and go untreated, which can severely decrease property values
Severe Weather - Vulnerability and impacts are a factor of type of event, strength of event, and area of impact.	5	Berks County is vulnerable to severe weather, including heavy fog, hail, heavy precipitation (rain), high winds, ice storms, unseasonable temperature extremes, and severe thunderstorms.	1	3	2	1	10.250	Minimal local impact; minimal potential for loss of life and injuries	Actions require to protect responders from hazards, particularly downed power lines	Limited impact; unlikely to cause relocation of government operations	Moderate impact; utility outages, transportation infrastructure closures, and isolated populations; varying levels of damage to structures, particularly mobile homes	Low impact; local disruption of basic life support systems, typically of short duration	Low impact on ecosystems	Limited impact on financial and commercial systems
Severe Winter Weather - Vulnerability and impacts are dependent upon the time and intensity of the event.	4	Berks County is vulnerable to an array of winter weather. This weather has the ability to close businesses, cancel classes, and disrupt roadways throughout the County.	2	3	3	1	10.200	Severe winter weather and freezing temperatures can result in hypothermia and other cold-related injuries, especially among the elderly; snow removal activities can lead to an increase in mortality caused by coronary failure	Low impact to emergency workers; primary impact from prolonged exposure to cold temperatures, secondary danger from vehicular accidents	Low impact to government; prolonged severe cold weather periods may require suspension of services such as public schools (This situation occurred during the winter of 1995-1996.)	Low impact; the primary consequence of prolonged severe cold weather is loss of power related to excessive demand and downed power lines resulting from ice storms	Limited impact; impact to service delivery would be to medical facilities, nursing homes, and assisted living facilities; some government offices may be required to shut down	Moderate impact; limited overall impact to the electric grid	Prolonged periods of extreme cold weather could have a major impact on business-related heating costs and could lead to short-term fuel shortages and inflation of heating oil and natural gas prices
Subsidence - Vulnerabilities and impacts are contingent upon numerous factors, including geographic location, whether it is gradual or catastrophic, and method of response.	4	Subsidence-related events occur several times each year, usually with minimal impact.	1	2	1	1	5.600	Nominal impact to the health and safety of people in the affected area as most events are not catastrophic in nature	Nominal impact to first responders	Little or no impact on continuity of government operations	Vital lifelines (roads, gas, and water pipelines) may be damaged as a result of subsidence	Limited impact on delivery of services	Limited environmental impact unless the subsidence shears pipelines or damages hazardous material storage facilities (above- or below-ground tanks, etc.)	Limited economic and financial impact to the community unless road networks are extensively damaged
Terrorism - Vulnerabilities and impacts are contingent upon the method of the attack, amount of force applied, and population density of the attack location.	1	On September 11, 2001, the United States was attacked by foreign terrorists. Flight 93 was a casualty of this attack. Pennsylvania has many targets of opportunity for terrorists: political, industrial, historical, and military.	3	3	3	3	3.000	Moderate impact to the health and safety of people in the affected area	Protective actions required to protect responders from chemical, nuclear, and biological hazard exposure	Impact on continuity of operations can range from nominal to catastrophic and would be contingent upon the type and location of the terrorism event	Impact on property, facilities, and infrastructure can range from nominal to catastrophic and would be contingent upon the type and location of the terrorism event	Impact on delivery of services can range from nominal to catastrophic and would be contingent upon the type and location of the terrorism event	Environmental impact can range from nominal to catastrophic and would be contingent upon the type and location of the terrorism event	Economic and financial impact to the community can range from nominal to catastrophic and would be contingent upon the type and location of the terrorism event
Tornado - Vulnerability and impacts are contingent upon the strength of the tornado, time of day, time on the ground, and area of impact.	4	According to the National Climatic Data Center, Berks County experienced 21 tornados between 1950 and 2002 which caused more than $15 million in damage. While usually of a lower magnitude, Berks County can witness larger tornados as well.	2	3	3	1	10.200	Extensive impact in the affected area; potential for mass fatalities and a large number of injured	Moderate impact; personal protective equipment (PPE) required for emergency worker safety from downed utility lines, hazardous materials, and debris	Low/limited impact because of the de-centralized nature of Pennsylvania's state government; however, some locally affected government agencies may be forced to relocate some mission-critical operations	Extensive local impact; massive failures in electrical, communications, and other community lifelines	Extensive impact; in the area of impact, widespread, short-term disruptions in basic life support services in affected areas; 911 systems temporarily overwhelmed	Low impact on ecosystems	Limited impact on financial and commercial systems

TABLE 4-17
(CONTINUED)

HAZARD		FREQUENCY OF OCCURRENCE AND LOCATION	IMPACT				RISK FACTOR	VULNERABILITY						
			CRITICAL FACILITIES (25% VULNERABILITY	SOCIAL (40% VULNERABILITY	ECONOMIC (25% VULNERABILITY	ENVIRONMENTAL (10% VULNERABILITY		(A) HEALTH AND SAFETY OF PERSONS IN THE AFFECTED AREA AT THE TIME OF THE INCIDENT (INJURY AND DEATH)	(B) HEALTH AND SAFETY OF ESSENTIAL PERSONNEL	(C) CONTINUITY OF GOVERNMENT	(D) PROPERTY, FACILITIES, AND INFRASTRUCTURE	(E) DELIVERY OF SERVICES	(F) THE ENVIRONMENT	(G) ECONOMIC AND FINANCIAL CONDITION
Transportation - Vulnerabilities and impacts are contingent upon numerous factors including location, timing and method of response. Some type of transportation event occurs every day with minimal impact.	5	Transportation accidents occur every day with minimal individual impact. The worst accidents will involve multiple vehicles or hazardous materials. These accidents are not as common. Also, airline, railway, and pipeline accidents can occur but are not frequent.	1	3	3	2	12.000	Fatal accidents occur on a daily basis	Nominal risk to first responders	Low impact on continuity of government operations	Moderate impact on property or infrastructure	Nominal impact on delivery of services	Environmental impact should be limited to the release of hazardous substances	Nominal impact
Urban Fire - Vulnerabilities and impacts are contingent upon numerous factors including geographic location, whether it is gradual or catastrophic and method of response. Some type of urban fire occurs every day with minimal impact.	5	Urban fires that involve one structure occur often with minimal impact. Major fires that involve more than one structure occur several times a year. The City of Reading is the most vulnerable to urban fires.	1	2	2	1	8.250	Urban structure fire-related deaths occur monthly	Moderate risk to emergency responders as a result of training and PPE	Low impact on continuity of government operations	Moderate impact on property or infrastructure	Nominal impact on delivery of services	Environmental impact should be limited to the release of hazardous substances	Nominal impact
Wildfire - Vulnerabilities and impacts are dependent on the location and climatologically/ meteorological conditions.	1	Berks County has experienced two wildfires since 1950. These events took place in Douglas Township and Pine Forge. Due to the nature of woody vegetation and relatively high moisture content, fire extent is typically limited. However, periods drought or dry weather may create conditions where vulnerability is elevated.	1	1	1	1	1.000	Low potential exists for fatalities and injuries	Moderate impact; actions required to protect responders from fire hazards	Low impact; unlikely to cause relocation of government operations	Low impact to transportation infrastructure, structures burned, and displaced populations	Low impact to delivery of services; services likely to be temporarily interrupted in the area of impact	Low impact to area of operations, including animal life, due to limited extent of fires	Low impact to the economic and financial community; primary impact will be to the replacement of structures in the area of operations

4.4.3.1 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 1 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.

4.4.3.2 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.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss for drought in Berks County was calculated to be $4,725,282.

4.4.3.3 Potential Flooding Losses

GIS data analysis indicates that there are approximately 4,467 occupied structures in the 100-year floodplain in Berks County. Based on available GIS data and a windshield survey, assuming that 90% (4,020) of these structures are residences, 8% (357) are commercial establishments, and 2% (90) are industrial buildings, the following losses can be estimated for Berks County's flooding hazard.

Residential = 4,020 Structures X $100,000 average value per structure X 10% impact* = $40,200,000
Commercial = 357 Structures X $350,000 average value per structure X 10% impact* = $12,495,000
Industrial = 90 Structures X $1.1 million average value per structure X 10% impact* = $9,900,000
Total = $62,595,000 (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 4-8 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 4-8 indicates that the 118 identified repetitive loss properties within Berks County account for 24% of the total NFIP flood loss claims to date. Table 4-8 also indicates that the NFIP has paid over $19 million in flood insurance claims payments to Berks County residents for reported flood losses. Finally, Table 4-8 indicates that 38 (53%) of Berks County's 72 municipalities have identified repetitive loss properties. This has increased since 2018. Figure 4-5 geographically shows the density of Repetitive Loss Properties by Municipality.

TABLE 4-18
BERKS COUNTY NFIP CLAIMS DATA BY MUNICIPALITY

MUNICIPALITY	FLOOD LOSS CLAIMS	TOTAL CLAIMS PAYMENTS ($) 1978-PRESENT	RESIDENTIAL REPETITIVE LOSS PROPERTIES	NON-RESIDENTIAL REPETITIVE LOSS PROPERTIES	TOTAL REPETITIVE LOSS PROPERTIES	NUMBER OF CORRESPONDING NFIP CLAIMS	AVERAGE NUMBER OF NFIP CLAIMS PER REPETITIVE LOSS PROPERTY	AMOUNT OF CORRESPONDING NFIP CLAIMS ($)	AVERAGE AMOUNT OF NFIP CLAIMS PER REPETITIVE LOSS PROPERTY ($)
Albany Township	38	165,952	1	0	1	4	4	56,354	14,089
Alsace Township	4	8,028	0	0	0	0	0	N/A	N/A
Amity Township	70	1,112,140	5	5	10	25	2.5	507,644	20,305
Bechtelsville Borough	7	119,039	1	0	1	3	3	98,875	32,958
Bern Township	17	206,661	3	0	3	7	2.3	133,544	19,078
Bernville Borough	0	0	0	0	0	N/A	N/A	N/A	N/A
Bethel Township	5	49,67644	0	0	0	N/A	N/A	N/A	N/A
Birdsboro Borough	29	290,763	0	1	1	3	3	136,431	45,477
Boyertown Borough	2	5,370	2	0	2	6	3	51,572	8,595
Brecknock Township	1	1,470	0	0	0	N/A	N/A	N/A	N/A
Caernarvon Township	1	5,957	0	0	0	N/A	N/A	N/A	N/A
Centerport Borough	0	0	0	0	0	N/A	N/A	N/A	N/A
Centre Township	6	42,166	1	0	1	2	2	25,232	12,616
Colebrookdale Township	13	42,221	3	0	3	4	1.3	37,110	9,278
Cumru Township	8	44,221	0	0	0	N/A	N/A	N/A	N/A
District Township	0	0	0	0	0	N/A	N/A	N/A	N/A
Douglass Township	47	1,036,395	7	0	7	16	2.3	768,372	48,023
Earl Township	38	653,453	10	2	12	40	3.3	1,053,334	26,333
Exeter Township	67	199,443	4	0	4	13	3.3	41,702	3,208
Fleetwood Borough	3	3,316	0	0	0	N/A	N/A	N/A	N/A
Greenwich Township	24	124,488	3	0	3	11	3	200,614	18,238
Hamburg Borough	37	165,547	2	0	2	4	2	17,347	4,337
Heidelberg Township	8	77,082	1	0	1	3	3	29,144	9,715
Hereford Township	1	0	0	0	0	N/A	N/A	N/A	N/A
Jefferson Township	2	23,589	0	0	0	N/A	N/A	N/A	N/A
Kenhorst Borough	5	37,532	0	0	0	N/A	N/A	N/A	N/A

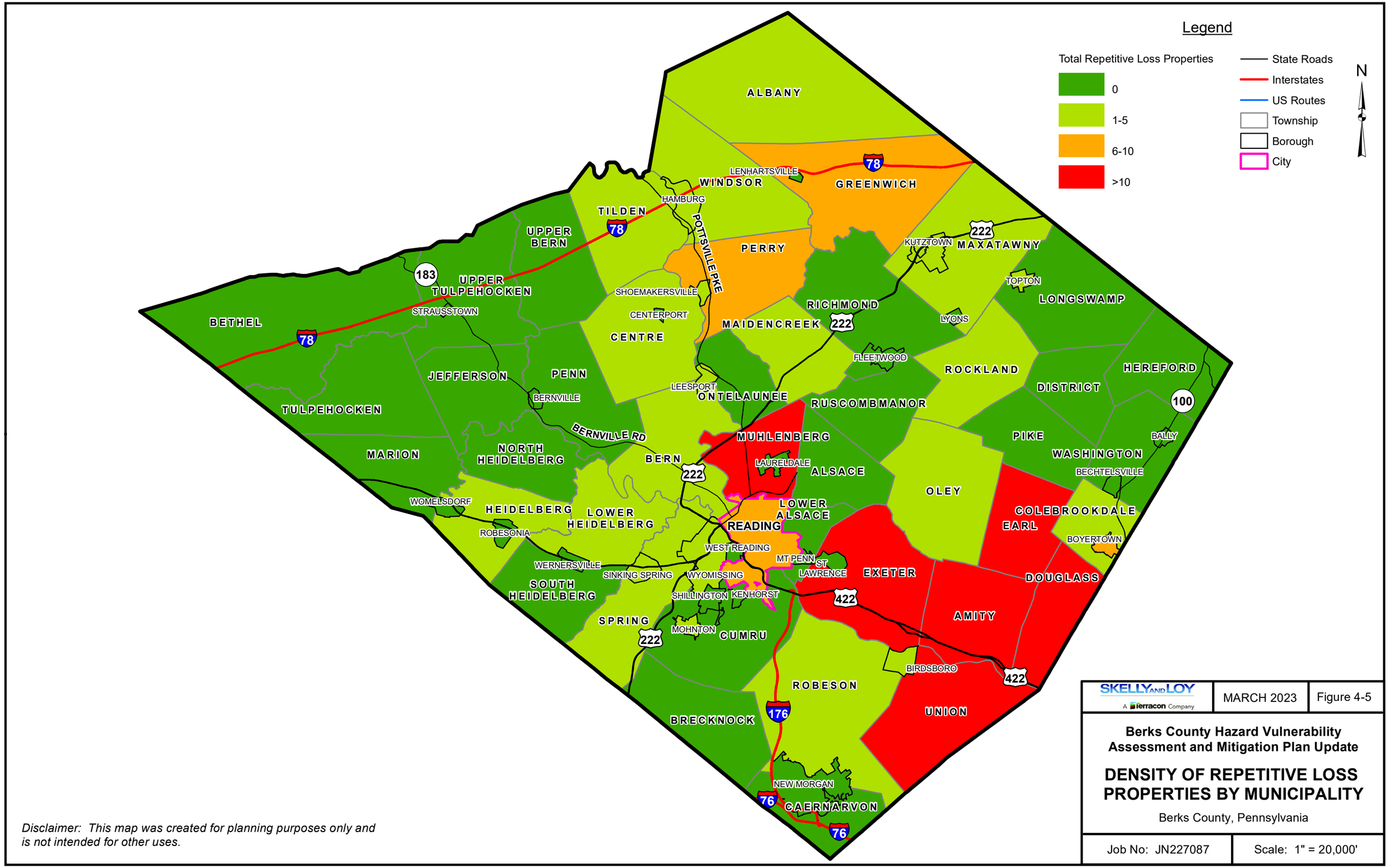
TABLE 4-18
(CONTINUED)

MUNICIPALITY	FLOOD LOSS CLAIMS	TOTAL CLAIMS PAYMENTS ($) 1978-PRESENT	RESIDENTIAL REPETITIVE LOSS PROPERTIES	NON-RESIDENTIAL REPETITIVE LOSS PROPERTIES	TOTAL REPETITIVE LOSS PROPERTIES	NUMBER OF CORRESPONDING NFIP CLAIMS	AVERAGE NUMBER OF NFIP CLAIMS PER REPETITIVE LOSS PROPERTY	AMOUNT OF CORRESPONDING NFIP CLAIMS ($)	AVERAGE AMOUNT OF NFIP CLAIMS PER REPETITIVE LOSS PROPERTY ($)
Kutztown Borough	72	966,954	2	3	5	13	2.6	319,962	24,613
Laureldale Borough	3	3,248	0	0	0	N/A	N/A	N/A	N/A
Leesport Borough	19	293,976	0	1	1	3	3	155,828	51,943
Lenhartsville Borough	10	139,785	0	0	0	N/A	N/A	N/A	N/A
Longswamp Township	2	2,315	0	0	0	N/A	N/A	N/A	N/A
Lower Alsace Township	9	13,623	0	0	0	N/A	N/A	N/A	N/A
Lower Heidelberg Township	7	602,940	1	0	1	4	4	56,995	14,249
Lyons Borough	N/A	N/A	0	0	0	N/A	N/A	N/A	N/A
Maidencreek Township	17	121,037	1	0	1	2	2	8,929	4,465
Marion Township	9	157,282	0	0	0	N/A	N/A	N/A	N/A
Maxatawny Township	14	288,726	2	0	2	6	3	249,735	41,622
Mohnton Borough	12	50,738	2	0	2	7	3.5	30,551	2,504
Mount Penn Borough	2	4,363	0	0	0	N/A	N/A	N/A	N/A
Muhlenberg Township	129	1,407,322	13	1	15	34	2.3	331,997	21,133
New Morgan Borough	0	0	0	0	0	N/A	N/A	N/A	N/A
North Heidelberg Township	2	4,570	0	0	0	N/A	N/A	N/A	N/A
Oley Township	11	97,638	1	0	1	2	2	6,662	3,331
Ontelaunee Township	40	201,096	0	0	0	N/A	N/A	N/A	N/A
Penn Township	0	0	0	0	0	N/A	N/A	N/A	N/A
Perry Township	39	908,892	5	0	5	13	2.3	238,615	47,723
Pike Township	2	22,721	0	0	0	N/A	N/A	N/A	N/A
Reading City	117	5,367,593	2	6	8	22	2.8	308,220	14,010
Richmond Township	25	173,929	2	0	2	4	2	127,917	31,979
Robeson Township	45	727,470	2	0	2	4	4	163,344	40,836
Robesonia Borough	6	25,767	0	0	0	N/A	N/A	N/A	N/A
Rockland Township	3	34,492	1	0	1	2	2	18,614	9,307

TABLE 4-18
(CONTINUED)

MUNICIPALITY	FLOOD LOSS CLAIMS	TOTAL CLAIMS PAYMENTS ($) 1978-PRESENT	RESIDENTIAL REPETITIVE LOSS PROPERTIES	NON-RESIDENTIAL REPETITIVE LOSS PROPERTIES	TOTAL REPETITIVE LOSS PROPERTIES	NUMBER OF CORRESPONDING NFIP CLAIMS	AVERAGE NUMBER OF NFIP CLAIMS PER REPETITIVE LOSS PROPERTY	AMOUNT OF CORRESPONDING NFIP CLAIMS ($)	AVERAGE AMOUNT OF NFIP CLAIMS PER REPETITIVE LOSS PROPERTY ($)
Ruscombmanor Township	0	0	0	0	0	N/A	N/A	N/A	N/A
Shillington Borough	4	38,523	0	0	0	N/A	N/A	N/A	N/A
Shoemakersville Borough	19	338,574	2	0	2	4	2	37,433	9,358
Sinking Spring Borough	2	16,839	1	0	1	2	2	16,839	8,420
South Heidelberg Township	4	2,926	0	0	0	N/A	N/A	N/A	N/A
Spring Township	16	389,553	1	0	1	2	2	30,068	15,034
St. Lawrence Borough	4	7,040	0	0	0	N/A	N/A	N/A	N/A
Strausstown Borough	0	0	0	0	0	N/A	N/A	N/A	N/A
Tilden Township	8	61,277	3	0	3	7	2.3	33,337	1,987
Topton Borough	4	28,143	0	1	1	4	4	56,254	14,064
Tulpehocken Township	2	6,595	0	0	0	N/A	N/A	N/A	N/A
Union Township	40	869,302	4	2	6	12	2	569,610	47,468
Upper Bern Township	3	186,137	1	0	1	2	2	186,137	93,069
Upper Tulpehocken Township	0	0	0	0	0	N/A	N/A	N/A	N/A
Washington Township	2	48,114	1	0	1	2	2	48,144	24,057
Wernersville Borough	4	8,038	1	0	1	2	2	6,643	3,322
West Reading Borough	16	791,067	0	0	0	N/A	N/A	N/A	N/A
Windsor Township	5	9,349	1	0	1	2	2	8,945	4,473
Womelsdorf Borough	5	18,486	1	0	1	5	5	18,486	3,697
Wyomissing Borough	30	112,109	1	2	3	8	2.7	52,948	6,619
Berks County Total	1,228	19,038	94	24	118	297	2.5	6,438,654	33,671

Note: Column 1 and 2 data current through 12/1/2022
Source: HUDEX Report, Policy and Loss Data by Community http://bsa.nfipstat.com/reports/reports.htm and NFIP Repetitive Loss Correction Worksheets for the County of Berks, PA



Disclaimer: This map was created for planning purposes only and is not intended for other uses.

SKELLY AND LOY
A Ferracon Company

MARCH 2023

Figure 4-5

Berks County Hazard Vulnerability Assessment and Mitigation Plan Update

DENSITY OF REPETITIVE LOSS PROPERTIES BY MUNICIPALITY

Berks County, Pennsylvania

Job No: JN227087

Scale: 1" = 20,000'

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 6.3.3) but can also be used to supplement the regional flood loss estimate.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss for flooding was calculated to be $3,175,814.

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 are shown in Appendix C. The complete loss estimate results and supporting documentation for these 13 representative floodplain structures are included in the appendices.

In addition, a HAZUS report was generated for potential flood losses for the 2023 plan update. The analysis used a 100-year storm event and analyzed building exposure to floodplains. Total economic loss, which includes building loss (building, content, and inventory loss/damage) and business interruption (income, relocation, rental income, and wage), was estimated to be $1 billion. Building loss was estimated to be only $675 million. The HAZUS report can be found in the appendices.

4.4.3.4 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.

HAZUS reports were generated for potential hurricane/tropical storm losses for the 2023 plan update. Reports were generated for storms with a 10-, 50-, and 100-year return period. The 10-year storm did not generate any economic loss. The 50-year hurricane generated $20,500 in economic losses, and the 100-year hurricane generated $6.2 million in economic losses. The HAZUS reports can be found in the appendices.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss from hurricanes/tropical storms in Berks County was calculated to be $279,051.

4.4.3.5 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 5% of these structures (of which 90% are residences, 8% are commercial, and 2% are industrial [based on 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

4.4.3.6 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 on a windshield survey and the history of past landslide events, it is estimated that only up to 5% (233) of these structures are expected to incur losses due to a landslide event over time. As such, assuming that 95% (221) of these structures are residences and 5% (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

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss from landslides in Berks County was calculated to be $85,441.

4.4.3.7 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. An updated HAZUS report was generated for the 2023 plan update for a 5.0 magnitude earthquake with an epicenter in the middle of the county (Muhlenberg Township). The total economic loss estimated for this earthquake was $6.6 billion. The HAZUS report can be found in the appendices.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss from earthquakes in Berks County was calculated to be $475,210.

4.4.3.8 Potential Severe Storm Losses

The best available historic damage estimate associated with severe storms is 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.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss for severe storms (includes hail, ice storm, lightning, strong wind
, and winter weather) in Berks County was calculated to be $4,453,919.

4.4.3.9 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.

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss from tornadoes in Berks County was calculated to be $3,534,543.

4.4.3.10 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 on a 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 (i.e., the Hopewell Wildfire). 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

The FEMA National Risk Index (2022) provides expected annual losses for natural hazards. The expected annual loss for a hazard is calculated as the specified geographic locations exposure, annualized frequency, and historic loss ratio. Expected annual loss from wildfires in Berks County was calculated to be $1,893.

4.4.4 Future Development and Vulnerability

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 experienced, and are continuing to experience, ample suburban development. Designated growth areas depicted in the Berks County Comprehensive Plan 2030 Update exist adjacent to current developed areas and were identified as currently vacant land that is appropriate for future urban high-density and suburban median-density development

requiring a full range of public services and facilities and including a balance of residential, commercial, industrial, institutional, and recreational uses. The designated growth areas are mainly located north, south, and east 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 Exeter and Amity Townships, 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. Figure 4-6 identifies the regional growth areas as mentioned above. Within Figure 4-6, the updated 2012 FEMA 100-year floodplain was used to assess the impacts which the proposed regional growth would have on the 100-year floodplain. Flood hazard areas are shown in red on Figure 4-6, and GIS analysis determined there are 596 areas of Zone A and AE 100-year floodplain located within the regional growth areas.

Land use and development trends in the far northern, western, 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 to the west and 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 flooding, 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.

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

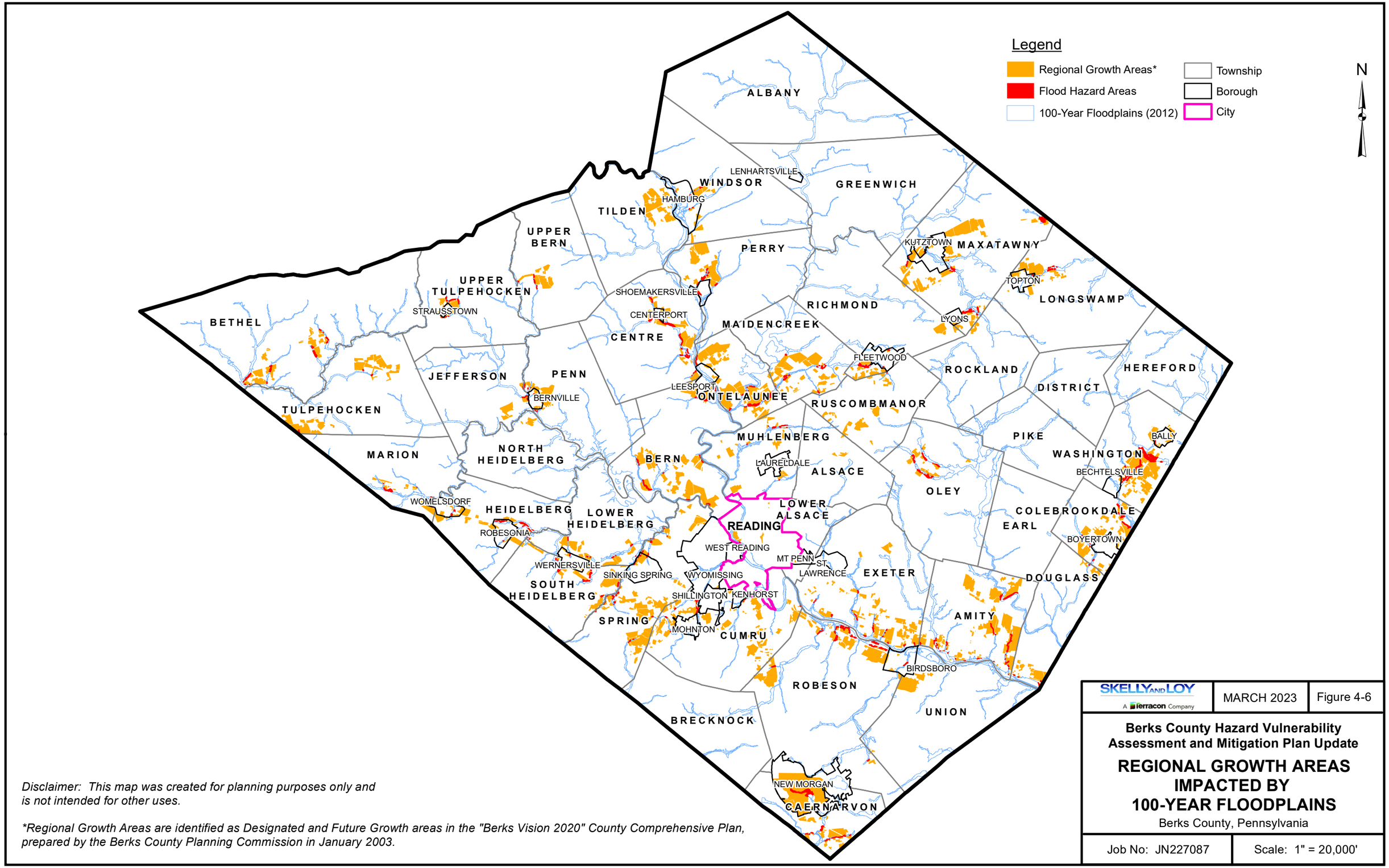
impact the entire County or any location in the County. Conversely, natural hazards such as dam failures, flooding, land subsidence, earthquakes, landslides, and wildfires are specific to certain locations and jurisdictions within the County as shown on the regional hazard event profile mapping and described in the preceding text.

Coordination completed with the Steering Committee revealed a need to map present day preserved areas throughout Berks County in comparison to existing development and known hazards. The purpose of this map, Figure 4-7, is to identify where the County can focus future conservation efforts to minimize the occurrence of natural hazards in relation to existing development. The mapping includes all conservation areas, open space, trail corridors, agricultural preservation areas and conservation easements as identified by the County. When compared to known hazard areas targeted for protection, the mapping reveals how efforts made in the past, such as Agricultural Conservation Easements surround and protect areas that are prone to flooding. This is one example of how the County can focus to conserve valuable farmland, while minimizing additional flooding by not having these rural agricultural lands developed.

4.4.5 Social Vulnerability and Community Resilience

Berks County's Social Vulnerability rating (38.23/100) indicates a relatively moderate susceptibility to the adverse impacts of natural hazards when compared to the rest of the U.S. Social Vulnerability is the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. A community's Social Vulnerability score is proportional to a community's risk. Berks County's Social Vulnerability rating was determined using the FEMA National Risk Index.

Berks County's Community Resilience rating (57.72/10) is relatively high when compared to the rest of the U.S. Community Resiliency is the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions. A community resilience score is inversely proportional to a community's risk. The Community Resilience rating for Berks County was determined using the FEMA National Risk Index.



Disclaimer: This map was created for planning purposes only and is not intended for other uses.

**Regional Growth Areas are identified as Designated and Future Growth areas in the "Berks Vision 2020" County Comprehensive Plan, prepared by the Berks County Planning Commission in January 2003.*

SKELLY AND LOY, A ferracon Company | MARCH 2023 | Figure 4-6

Berks County Hazard Vulnerability Assessment and Mitigation Plan Update

REGIONAL GROWTH AREAS IMPACTED BY 100-YEAR FLOODPLAINS

Berks County, Pennsylvania

Job No: JN227087 | Scale: 1" = 20,000'

Legend

- Agricultural Conservation Easements
- Other Easements
- Known Hazard Areas Targeted for Protection

FUTURE LAND USE (2030 UPDATE)

- Existing Development
- Permanent Open Space and Recreation

- State Roads
- Interstates
- US Routes
- Township
- Borough
- City

N

ALBANY
LENHARTSVILLE
WINDSOR
GREENWICH
HAMBURG
TILDEN
UPPER BERN
POTTSVILLE PKE
PERRY
KUTZTOWN
MAXATAWNY
222
183
UPPER TULPEHOCKEN
SHOEMAKERSVILLE
TOPTON
LONGSWAMP
BETHEL
STRAUSSTOWN
CENTERPORT
RICHMOND
LYONS
CENTRE
MAIDENCREEK
FLEETWOOD
JEFFERSON
PENN
ROCKLAND
HEREFORD
LEESPORT
ONTELAUNEE
DISTRICT
BERNVILLE
RUSCOMBMANOR
100
TULPEHOCKEN
BERNVILLE RD
MUHLENBERG
PIKE
BALLY
MARION
NORTH HEIDELBERG
BERN
LAURELDALE
ALSACE
WASHINGTON
BECHTELSVILLE
OLEY
WOMELSDORF
HEIDELBERG
LOWER HEIDELBERG
LOWER ALSACE
COLEBROOKDALE
EARL
READING
ROBESONIA
WEST READING
BOYERTOWN
MT PENN
ST LAWRENCE
WERNERSVILLE
SINKING SPRING
WYOMISSING
EXETER
DOUGLASS
SOUTH HEIDELBERG
SHILLINGTON
KENHORST
422
AMITY
SPRING
MOHNTON
CUMRU
BIRDSBORO
ROBESON
UNION
BRECKNOCK
176
NEW MORGAN
76
CAERNARVON

Disclaimer: This map was created for planning purposes only and is not intended for other uses.

SKELLY AND LOY, A ferracon Company	MARCH 2023	Figure 4-7

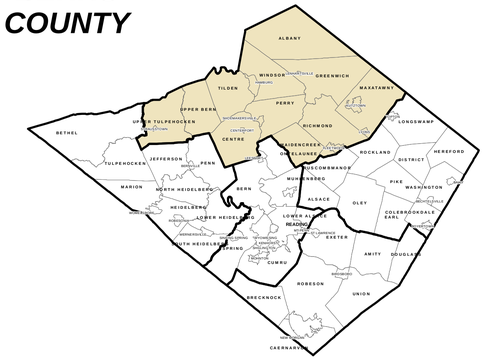
Berks County Hazard Vulnerability Assessment and Mitigation Plan Update

HAZARD PRESERVATION AREAS

Berks County, Pennsylvania

Job No: JN227087	Scale: 1" = 20,000'

BERKS COUNTY



HAWK MOUNTAIN PLANNING DISTRICT

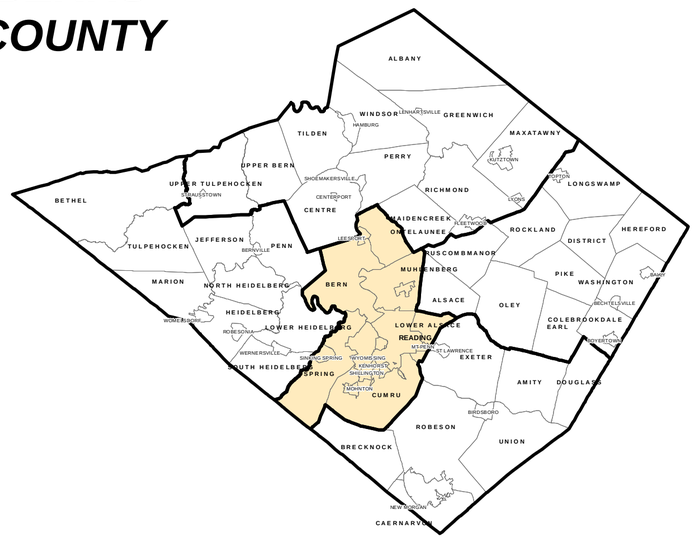
Legend

- Airport
- Dam
- Daycare
- EMS Station
- EOC
- Fire Station
- Hospital
- Municipal Building
- Police Station
- Private School
- Public School
- Higher Education
- Representative Structures
- Sinkhole
- Interstate / US Route / State Route
- Local or Private Road
- Ramp
- Proposed Road
- Railroad
- Streams
- 100-year Floodplain
- Municipal Boundaries
- Carbonate Bedrock Geology
- Forested Land Cover
- Landslide Hazard Areas
- Structures
- Floodprone Structures
- Wildland/Urban Interface Structures

ALBANY
WINDSOR
GREENWICH
UPPER TULPEHOCKEN
UPPER BERN
TILDEN
CENTRE
PERRY
RICHMOND
MAIDENCREEK
MAXATAWNY
SHOEMAKERSVILLE
CUATROS VIENTOS
KING AIR
ALBANY TOWNSHIP MUNICIPAL BUILDING
ALBANY TOWNSHIP EOC
ALBANY ELEMENTARY SCHOOL
HAMBURG RESERVOIR DAM
NEW KERNSVILLE DAM
BLUE MOUNTAIN LAKE DAM
HAMBURG FLOOD CONTROL (PA-476) DAM
FEMA REGION III EOC
HAMBURG
HAMBURG CENTER
HAMBURG BOROUGH MUNICIPAL BUILDING
HAMBURG POLICE
HAMBURG BOROUGH EOC
HAMBURG AREA HIGH SCHOOL
HAMBURG AREA MIDDLE SCHOOL
BLUE MOUNTAIN ACADEMY (PVT)
TILDEN TOWNSHIP MUNICIPAL BUILDING
TILDEN TWP POLICE
TILDEN TOWNSHIP EOC
WINDSOR TOWNSHIP MUNICIPAL BUILDING
WINDSOR TOWNSHIP EOC
CHRISTMAN DAM
LENHARTSVILLE BOROUGH EOC
LENHARTSVILLE BOROUGH MUNICIPAL BUILDING
GREENWICH TOWNSHIP EOC
GREENWICH TOWNSHIP MUNICIPAL BUILDING
GREENWICH-LENHARTSVILLE ELEMENTARY SCHOOL
DON'S PLACE AIRPARK
VIRGINVILLE FIRE CO
PERRY TOWNSHIP EOC
PERRY TOWNSHIP MUNICIPAL BUILDING
SHOEMAKERSVILLE BOROUGH MUNICIPAL BUILDING
SKYLINE AIRSTRIP
PERRY ELEMENTARY SCHOOL
SHOEMAKERSVILLE FIRE CO
SHOEMAKERSVILLE
UPPER TULPEHOCKEN TOWNSHIP EOC
UPPER TULPEHOCKEN TOWNSHIP MUNICIPAL BUILDING
STRAUSSTOWN BOROUGH MUNICIPAL BUILDING
UPPER BERN TOWNSHIP MUNICIPAL BUILDING
SHARTLESVILLE FIRE CO
THE OLD COMMONWEALTH AERODROME
CENTERPORT BOROUGH MUNICIPAL BUILDING
CENTERPORT BOROUGH EOC
CENTRAL BERKS FIRE CO
CENTRE TOWNSHIP MUNICIPAL BUILDING
CENTRE TOWNSHIP EOC
KUTZTOWN BOROUGH MUNICIPAL BUILDING
KUTZTOWN AREA TRANSPORT
MAXATAWNY TOWNSHIP EOC
MAXATAWNY TOWNSHIP MUNICIPAL BUILDING
KUTZTOWN AREA SR HIGH SCHOOL
KUTZTOWN UNIVERSITY
LEHIGH VALLEY HEALTH NETWORK KUTZTOWN
RICHMOND TOWNSHIP EOC
RICHMOND TOWNSHIP MUNICIPAL BUILDING
RICHMOND ELEMENTARY SCHOOL
LYONS BOROUGH MUNICIPAL BUILDING
LYONS FIRE CO
FLEETWOOD AREA SENIOR HIGH SCHOOL
FLEETWOOD POLICE
FLEETWOOD BOROUGH MUNICIPAL BUILDING
FLEETWOOD AMBULANCE
WILLOW CREEK ELEMENTARY CENTER
MAIDENCREEK TOWNSHIP MUNICIPAL BUILDING
ANDREW MAIER ELEMENTARY SCHOOL
78
222
N
0 2,250 4,500 9,000 Feet

Disclaimer: This map was created for planning purposes only and is not intended for other uses.

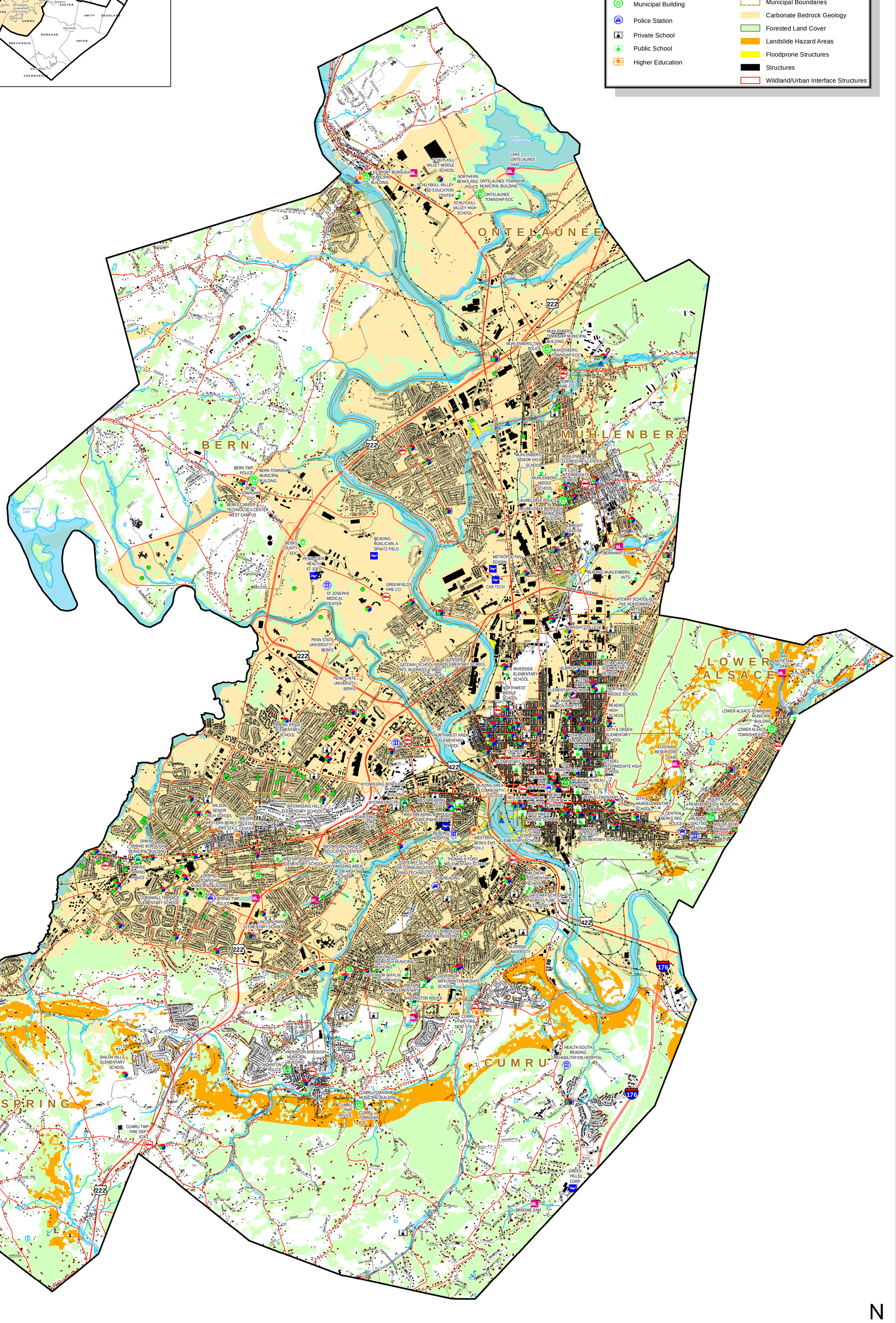
BERKS COUNTY



METRO PLANNING DISTRICT

Legend

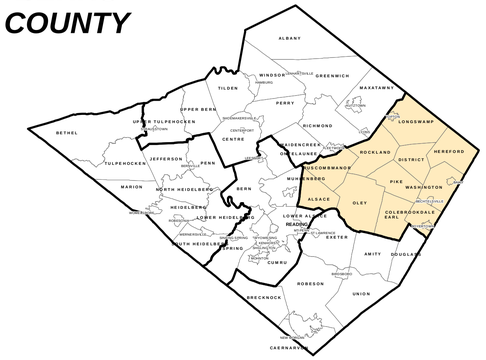
- Wildland/Urban Interface Structures
- Airport
- Dam
- Daycare
- EMS Station
- EOC
- Fire Station
- Hospital
- Municipal Building
- Police Station
- Private School
- Public School
- Higher Education
- Representative Structures
- Sinkhole
- Interstate / US Route / State Route
- Local or Private Road
- Ramp
- Proposed Road
- Railroad
- Streams
- 100-year Floodplain
- Municipal Boundaries
- Carbonate Bedrock Geology
- Forested Land Cover
- Landslide Hazard Areas
- Floodprone Structures
- Structures
- Wildland/Urban Interface Structures

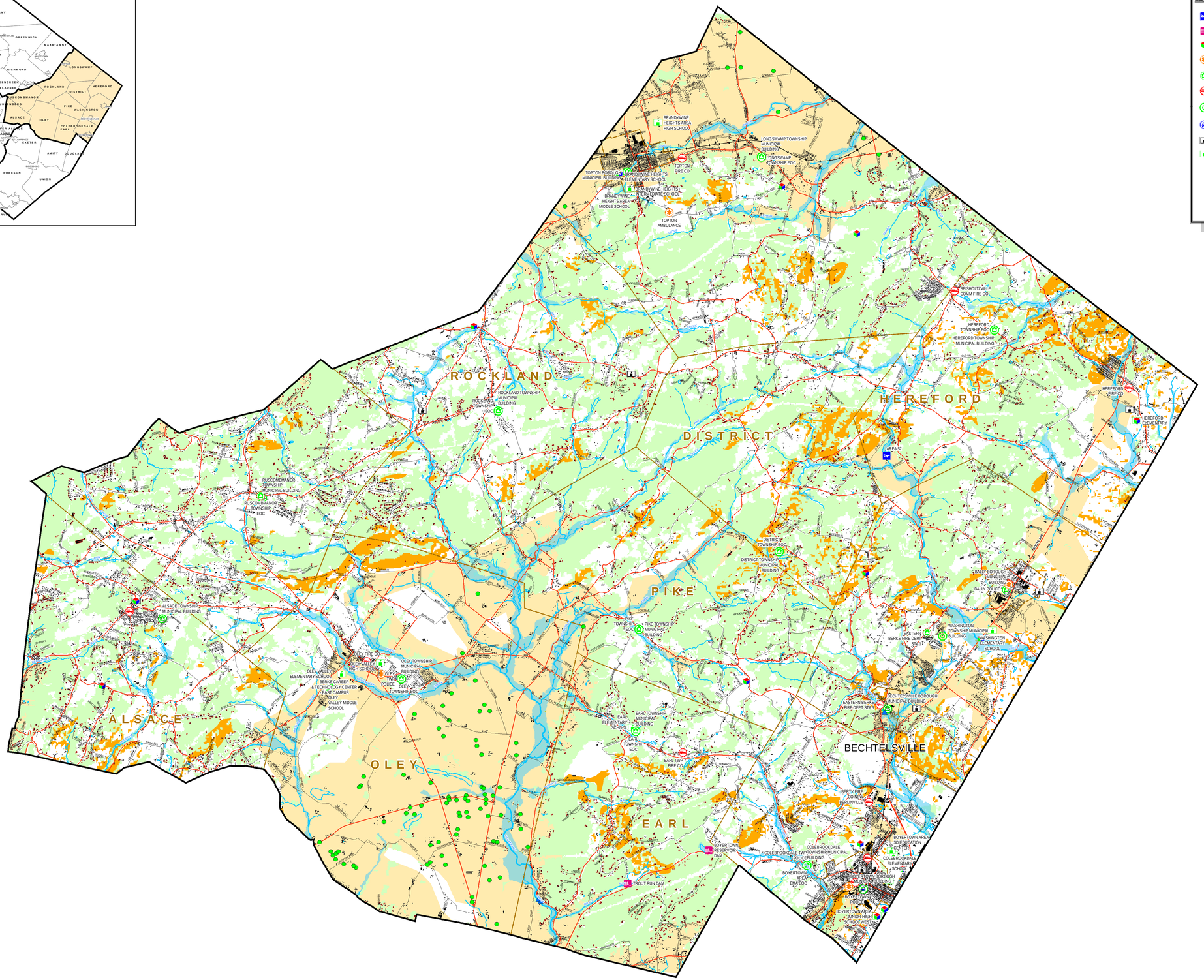


Disclaimer: This map was created for planning purposes only and is not intended for other uses.

OLEY HILLS PLANNING DISTRICT

BERKS COUNTY





Legend

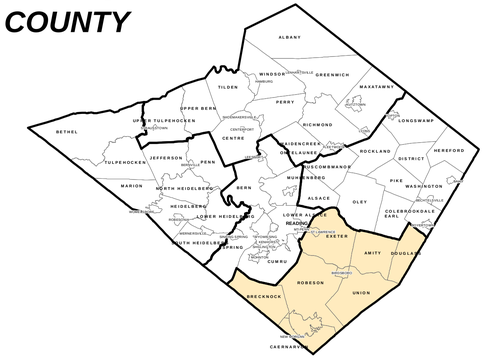
- Airport
- Dam
- Daycare
- EMS Station
- EOC
- Fire Station
- Municipal Building
- Police Station
- Private School
- Public School
- Representative Structures
- Sinkhole
- Interstate / US Route / State Route
- Local or Private Road
- Ramp
- Proposed Road
- Railroad
- Streams
- 100-year Floodplain
- Municipal Boundaries
- Carbonate Bedrock Geology
- Forested Land Cover
- Landslide Hazard Areas
- Floodprone Structures
- Structures
- Wildland/Urban Interface Structures

N

0 2,000 4,000 8,000 Feet

Disclaimer: This map was created for planning purposes only and is not intended for other uses.

BERKS COUNTY



SOUTHERN HILLS PLANNING DISTRICT

Legend

- Airport
- Dam
- Daycare
- EMS Station
- EOC
- Fire Station
- Municipal Building
- Police Station
- Private School
- Public School
- Representative Structures
- Sinkhole
- Interstate / US Route / State Route
- Local or Private Road
- Ramp
- Proposed Road
- Railroad
- Streams
- 100-year Floodplain
- Municipal Boundaries
- Carbonate Bedrock Geology
- Forested Land Cover
- Landslide Hazard Areas
- Floodprone Structures
- Structures
- Wildland/Urban Interface Structures

N

0 2,000 4,000 8,000 Feet

Disclaimer: This map was created for planning purposes only and is not intended for other uses.

TULPEHOCKEN PLANNING DISTRICT

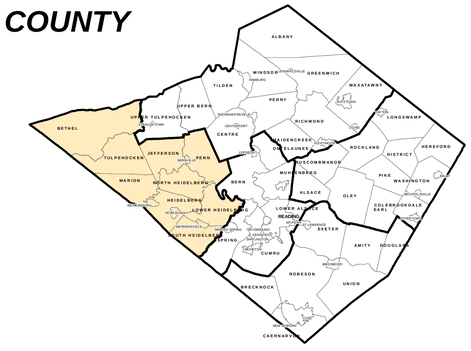
Legend

- Airport
- Dam
- Daycare
- EMS Station
- EOC
- Fire Station
- Hospital
- Municipal Building
- Police Station
- Private School
- Public School
- Representative Structures
- Sinkhole
- Interstate / US Route / State Route
- Local or Private Road
- Ramp
- Proposed Road
- Railroad
- Streams
- 100-year Floodplain
- Municipal Boundaries
- Carbonate Bedrock Geology
- Forested Land Cover
- Landslide Hazard Areas
- Floodprone Structures
- Structures
- Wildland/Urban Interface Structures

BETHEL
TULPEHOCKEN
JEFFERSON
PENN
MARION
HEIDELBERG

BETHEL-TWP POLICE
BETHEL ELEMENTARY SCHOOL
BETHEL COMMUNITY AMBULANCE STA 1
BETHEL TOWNSHIP MUNICIPAL BUILDING
BETHEL TOWNSHIP EOC
FRYSTOWN FIRE CO
K9/ILL PERSONAL USE
GRIMES
TULPEHOCKEN TOWNSHIP MUNICIPAL BUILDING
TULPEHOCKEN TWP POLICE
TULPEHOCKEN TOWNSHIP EOC
REHRERSBURG FIRE CO
MT AETNA FIRE CO
TULPEHOCKEN JR-SR HIGH SCHOOL
TULPEHOCKEN AREA SD EDUCATION CENTER
JEFFERSON TOWNSHIP MUNICIPAL BUILDING
PENN-BERNVILLE SCHOOL
BERNVILLE BOROUGH MUNICIPAL BUILDING
BERNVILLE POLICE
PENN TOWNSHIP EOC
PENN TOWNSHIP MUNICIPAL BUILDING
MARION TOWNSHIP FIRE CO MUNICIPAL BUILDING
NORTH HEIDELBERG TOWNSHIP EOC
NORTH HEIDELBERG TOWNSHIP MUNICIPAL BUILDING
HEIDELBERG TOWNSHIP EOC
HEIDELBERG TOWNSHIP MUNICIPAL BUILDING
HEIDELBERG TWP POLICE
CONRAD WEISER WEST ELEMENTARY SCHOOL
ROBESONIA BOROUGH MUNICIPAL BUILDING
CONRAD WEISER AREA HIGH SCHOOL
CONRAD WEISER MIDDLE SCHOOL
FURNACE CREEK DAM
MILL DAM
WERNERSVILLE STATE HOSPITAL
WERNERSVILLE BOROUGH MUNICIPAL BUILDING
CONRAD WEISER EAST ELEMENTARY SCHOOL
BOYER
WESTERN BERKS FIRE DEPT STA 4
LOWER HEIDELBERG POLICE
LOWER HEIDELBERG TOWNSHIP MUNICIPAL BUILDING
LOWER HEIDELBERG TOWNSHIP EOC
WILSON WEST MIDDLE SCHOOL
GREEN VALLEY ELEMENTARY CENTER
SOUTH HEIDELBERG TOWNSHIP MUNICIPAL BUILDING

BERKS COUNTY



Disclaimer: This map was created for planning purposes only and is not intended for other uses.

N

0 2,000 4,000 8,000 Feet

5.0 CAPABILITY ASSESSMENT

5.1 UPDATE PROCESS SUMMARY

A capability assessment involves an evaluation of the County in regard to its governmental structure, political framework, legal jurisdiction, financial 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 bodies, 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 among its 72 constituent municipalities.

5.2 CAPABILITY ASSESSMENT FINDINGS

5.2.1 Planning and Regulatory 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, sub-division and land development (SLD), 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 PMs. 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, SLD, 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. Since 1997, the Berks County Planning Commission, on behalf of the County Commissioners has been promoting and implementing cooperation, partnerships, coordination, and intergovernmental initiatives among municipalities throughout Berks County.

The Capability Assessment Matrix, included in the appendices, has been prepared to document the County's and its constituent municipalities' existing planning and regulatory 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. PM hazard mitigation recommendations are based on the information contained in this matrix.

5.2.2 Administrative and Technical Capability

Regarding administrative capability, Berks County's 72 constituent municipalities include 1 city, 27 boroughs, and 44 townships. Each of these municipalities carries out its daily operations and provides various community services according to its 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, financial 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 in 2020 of 180

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 95,112 persons in 2020. 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.

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., planning, regulatory, administrative, and financial) 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 among 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, Berks County DES, and other organizations and offices of the County. Many of these offices also draw upon extensive volunteer support. Such is the case for Berks County DES, which 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.

In addition to the administrative and technical capabilities 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, federal government, local COGs, watershed groups, environmental groups, or some other entity, the results could be limitless.

5.2.3 Financial 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 financial capability is to analyze how tight these constraints are. This could involve a detailed auditing process to tally all revenues and expenditures, or it 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 financial 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 the City of Reading was the only Berks County municipality identified on November 12, 2009, as being fiscally distressed according to the established rating criteria. As of July 2022, the City of Reading officially exited Act 47.

It is important to remember that finances are not the only factor in determining financial capability. There are numerous partnering opportunities and grant programs available to assist in offsetting the expenses of local hazard mitigation efforts. Thanks to PA DEP's Growing Greener grant program, there are numerous watershed associations available for municipalities to partner with to accomplish hazard mitigation activities. Within Berks County, watershed associations have been formed for:

- Angelica Creek,
- Allegheny Creek
- Cocalico Creek,
- Furnace Creek
- Hay Creek,
- Little Swatara Creek,
- Maiden Creek,

- Mill Creek,
- Pine Creek,
- Wyomissing Creek,
- Perkiomen Watershed Conservancy,
- Schuylkill Action Network,
- Tulpehocken Creek and Blue Marsh Lake,
- Trout Unlimited – Perkiomen Valley Chapter, and
- Trout Unlimited – Tulpehocken Chapter.

In addition, there are partnering opportunities at the local level with the BCCD, BCPC, DRBC, Berks County DES PA American Water Works Association, Water Works Operators of PA, Eastern PA Water Pollution Control Operators Association, Berks County Sewer and Water Authority, Berks County MS4 Steering Committee, and Berks County Source Water Protection Program. 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; PA DEP's Growing Greener, Source Water Protection, and Flood Protection Programs; 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.

Berks County prepared a Chesapeake Bay Action Plan (BAP) in 2021 that addresses the County's approach, initiatives and considerations for existing and proposed water quality improvements in the Chesapeake Bay drainage areas of the county. The Berks BAP, in conjunction with state efforts, aims to ultimately reduce approximately 620,000 pounds of nitrogen and 21,000 pounds of phosphorous annually to local streams and water resources through BMPs implemented by 2025.

5.2.4 Education and Outreach

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 and Maidencreek, Maxatawny, and Richmond Townships, leaving behind $1.4 million in damages. The 2011 floods left portions of Berks County under water in September 2011. In addition, Berks

County experienced the Hopewell Wildfire in April 2012, the largest wildfire in Berks County's history. Given these relatively significant recent events and the severity of the 1972 Agnes event, Berks County recognizes that educating its residents and business owners is an important consideration when planning for and implementing local hazard mitigation activities.

Consequently, Berks County is very active in regard to education and outreach related to hazard mitigation, emergency management, and local planning initiatives. The Berks County DES planning staff participates in regular public outreach promoting emergency planning, hazard mitigation, and preparedness. Berks County DES averages twelve outreach programs annually throughout the County. Some of these outreach efforts include:

- **National Night Out** is a multi-municipality event involving Spring Township, the City of Reading, Ontelaunee, Leesport, Maidencreek, Fleetwood, Richmond, Hamburg and Muhlenberg.

- **Get Outdoor Days** at Blue Marsh Lake in Bern Township is an event sponsored by the U.S. Army Corp of Engineers.

- **Local Business and Industry Events**, including Can Corporation (Maidencreek), Quacker Meats (Reading), Elite Sportswear (Reading), the Center for Excellence in Local Government through Albright University, Berks Nature/The Nature Place through Alvernia University, Berks County Intermediate Unit (BCIU) Special Needs Fair (Muhlenberg), Berks County Sewer and Water Association (BCS&WA) events represented by multiple sewer and water authorities.

Additionally, Berks DES provides In-Service Training (IST) to Local Emergency Management Coordinators (EMC), local elected officials, and EMA staff. Berks County is mandated to provide two sessions each year per PEMA D2022-2. Berks DES provides 18 hybrid (in-person/virtual) sessions per year and provides an online component on PowerDMS. PowerDMS is a platform where individuals can view prerecorded IST sessions which are uploaded to PowerDMS with quiz attached and taken on their own time. Topics range in nature and touch on the five phases of emergency management; Prevention, Preparedness, Response, Mitigation and Recovery. During 2022, PEMA Bureau of Hazard Mitigation provided two sessions on Hazard Mitigation Planning/Mitigation Projects. More information on educational programs is available in the Berks County Training and Exercise Preparedness Plan 2023 – 2027.

Finally, during the 2022 festival season, Berks County attended several events to educate and to receive comment on the Berks County Hazard Vulnerability Analysis and Mitigation Plan from the public. The events were well attended and able to reach a greater number of the public. Events attended included the Muhlenberg River Fest, the West Reading Fall Festival, and partnered with the Berks County Heritage Center over multiple weekends at special events held at

the Heritage Center in Bern Township. Berks County looks to expand outreach and education by routinely attending festivals, and large community events to better reach the residents of Berks County.

5.2.5 Plan Integration

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 new or amend their existing Comprehensive Plans 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 Plans, thus fulfilling PM-1. By so doing, those municipalities will be integrating 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, SLD 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 planning capability outlined in Section 5.2.1 above 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 property 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.

6.0 MITIGATION STRATEGY

6.1 UPDATE PROCESS SUMMARY

The Mitigation Steering Committee identified and prioritized project-planning goals following 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.

As part of the plan update, the Mitigation Steering Committee reviewed the existing hazard mitigation goals for content and for priority.

6.2 MITIGATION GOALS AND OBJECTIVES

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 forecasting and warning programs are adequate throughout the County.

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

- Encourage and assist municipalities and emergency services organizations to equip and train for high probability hazard events.

- Ensure the maintenance of healthcare and/or public health infrastructure.

- Maintain dam integrity throughout Berks County to protect resident lives through; dam rehabilitation and/or removal of dams.

- Continue to work with dam owners/operators in the planning process.

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 (BMPs) 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.

- Ensure that emergency communications systems are available and adequate at all levels throughout the County.

- Coordinate existing and new plans across and among major employers, industries and institutions such as colleges/universities and hospitals.

- Adopt and enforce land use ordinances in identified inundation areas to limit new structures to be built in inundation flood areas.

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.

- Implement flood protection measures such as berms and floodwalls within identified inundation areas and flood zones.

- Acquire easements within identified inundation areas.

6.3 IDENTIFICATION AND ANALYSIS OF MITIGATION TECHNIQUES

6.3.1 Preventive Measures

PMs 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. PMs are usually administered by local building, zoning, planning, and/or code enforcement officials and typically include the following:

- land use planning/zoning efforts;
- SLD ordinances;

- building codes;
- floodplain development regulations;
- stormwater management;
- operations and maintenance (O&M) procedures;
- subsurface investigation requirements;
- public education programs;
- burning restrictions; and
- water supply monitoring

Implementation of PMs 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)

6.3.1.1 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 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.

6.3.1.2 Subdivision and Land Development Ordinances

SLD ordinances regulate how land can be subdivided into individual lots and establish certain standards/criteria for the location and construction of buildings and associated infra-structure (i.e., roads, sidewalks, utility lines, stormwater management facilities, etc.). As such, local SLD 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 sub-division design principles could also be employed to minimize/mitigate the potential impacts of natural hazards. Conservation subdivision design principles involve clustering homes/develop-ment 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 Smart Growth land use concepts is included in the

appendices for reference purposes). As such, the Mitigation Steering Committee identified the following PM Hazard Mitigation Measure to be implemented within the County.

PM-5: As 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.

6.3.1.3 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 Building Officials and Code Administrators (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 ongoing implementation of the UCC and the potential local adoption of more stringent standards for hazard-resistant construction as a PM Hazard Mitigation Measure for the County.

PM-7: Enforce the minimum building standards of the Pennsylvania UCC and/or consider the potential adoption of more stringent building standards to ensure hazard-resistant construction, including greater resistance to severe weather events (namely hailstorms).

6.3.1.4 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. This is including and not limited to benefits for underserved or underprivileged social vulnerable communities.

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 PM 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 allows her/his review and concurrence on plans for proposed construction or substantial improvement of existing construction in the floodplain. In the absence of a County Floodplain Management Coordinator, Berks County should appoint a temporary Coordinator or rehire a new, permanent County Floodplain Management Coordinator. PM-9 was removed at the request of Berks County DES.

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.

6.3.1.5 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 SLD ordinance, require developers to construct on-site stormwater management facilities that will effectively collect, convey, and store surface water runoff.

Municipalities who have adopted Act 167 ordinances should be sure that they are in compliance with DEP's 2022 model ordinance in order to fulfill MS4 permit requirements. Those municipalities not regulated under the MS4 permit program should have an ordinance which meets minimal requirements for erosion and sedimentation controls. PM statements here could include working with the Berks County MS4 Steering Committee for education and outreach. Ongoing review of stormwater regulations.

PM-11: If funding should become available through the PA DEP's Act 167 Stormwater Management Program, pursue the preparation of a countywide Act 167 Stormwater Management Plan.

6.3.1.6 Operations and Maintenance Procedures

Effective implementation of appropriate 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 PM 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.

6.3.1.7 Subsurface Investigation Requirements

Subsurface investigation requirements for new SLD 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 SLD 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 PM Hazard Mitigation Measure to be implemented within the County.

PM-13: Revise existing zoning and/or SLD 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 SLD projects in known land subsidence hazard areas.

6.3.1.8 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 USFS'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 PM Hazard Mitigation Measure to be implemented at the County level. This public education program is to be a joint effort between Berks County DES 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 PM 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.

6.3.1.9 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 PM Hazard Mitigation Measure to be implemented within the County and as revised in accordance with the updated plan.

PM-16: Adopt an ordinance to ban open burning as conditions warrant in wildfire hazard areas or throughout the municipality.

6.3.1.10 2012 Plan Update Mitigation Measures

As part of the review process the Mitigation Steering Committee requested that PM-9 and PM-16 be revised. Given that Berks County does not have a Floodplain Management Coordinator, it was recommended that one be temporarily appointed or that position be filled. The Committee members chose to revise the language within PM-16 to define open burning be banned "as conditions warrant" rather than as previously defined "during designated times of the year" (see above Section 6.3.1.9 for burn restrictions). There were no other specific changes to PMs.

6.3.1.11 2017 Plan Update Mitigation Measures

Mitigation Measures PM-17 and PM-18 were adapted from the FEMA Mitigation Ideas (2013) resource and agreed upon at a Mitigation Steering Committee meeting.

PM-17: Identify local drought indicators and establish a regular schedule to monitor and report conditions.

PM-18: Develop agreements for secondary water sources that may be used during drought conditions.

PM-19: Require municipalities to adopt updates to UCCs.

6.3.1.12 2023 Plan Update Mitigation Measures

The following new preventive measures were identified during the 2023 update:

PM 20: Municipalities shall designate a Floodplain Administrator to comply with provisions of the National Flood Insurance Program Section 60.3 (d) and the Pennsylvania Floodplain Management Act (Act 166-1978).

PM 21: The municipal separate storm sewer system (MS4) requirements must be adhered to for municipalities located in "urban settings" as designated per the 1990 and 2000 census. According to DEP, municipalities located within the MS4 designation must follow the Minimum Control Measures (MCMs) as described below:

- **Public education and outreach**
- **Public involvement and participation**
- **Illicit discharge detection and elimination**
- **Construction site runoff control**
- **Post-construction stormwater management in new development and redevelopment**
- **Pollution prevention and good housekeeping for municipal operations and maintenance**

6.3.2 Emergency Services

Emergency services (ES) 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 EOC. As such, adopting and implementing the EOP is a critical first step in providing local ES measures in response to a natural hazard event. Berks County and all 72 of its constituent municipalities updated their EOPs in 2003. With this critical plan in place, Berks County can investigate more specific ES 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 ES 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)

6.3.2.1 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 USGS 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 ES Hazard Mitigation Measures listed below to be implemented within the County. As part of the 2012 updated plan, the following ES Hazard Mitigation Measures were revised based on input from Berks County DES: ES-1, ES-7, ES-9, ES-10, ES-14, ES-16, ES-17, ES-18, ES-21, and ES-25.

ES-1: Develop a real-time Web portal that would provide a link to Berks County information (i.e., County website: http://www.berksdes.com) during non-emergencies but act as an extension of the Emergency Alert System in times of pending disaster and during a disaster. Additional real-time Web resources include http://www.facebook.com/BerksCountyDES and Twitter@BerksDES. Berks County DES believes this has been accomplished as of September 29, 2017.

ES-2: Participate in the NWS's StormReady Program, a nationwide program that helps communities develop plans to handle all types of severe weather. Berks County became StormReady on May 31, 2018, and is certified through 2025.

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 USGS, local watershed organizations, and/or the BCCD to increase the number of USGS 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: Continue to support EMCs with technical assistance for their high bandwidth wireless service and/or pagers as a means of maintaining 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 and is maintained at the local level.

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

6.3.2.2 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 ES 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: Review grant opportunities to implement a system similar to PennDOT's RWIS (Road and Weather Information System), completed on Interstate 78, that will monitor major arteries in Berks County and report this information to the County's website.

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 website.

ES-16: Provide generators for every municipal EOC and possibly those critical facilities that do not currently have one. ES-16 was removed at the request of Berks County DES.

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

ES-18: Ensure the Limerick Power Plant operator maintains and updates evacuation plans on a consistent basis.

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

6.3.2.3 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 ES 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 --
Berks County DES should consider partnering with the owners/operators of critical facilities to provide adequate planning and protection.

6.3.2.4 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 ES Hazard Mitigation Measures to be implemented within the County.

ES-21: Develop and distribute potential health and safety implications of various natural hazard events on the Berks County DES website (http://www.berksdes.com) and through local press releases.

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.

6.3.2.5 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 under-staffed 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 ES 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 County DES website that contains information related to the Hazard Mitigation Plan and educational materials for hazard mitigation measures (http://www.berksdes.com).

6.3.2.6 2012 Plan Update Mitigation Measures

Coordination completed with the Mitigation Steering Committee as part of the update process resulted in eight new mitigation measures. Mitigation measures ES-26, ES-27, ES-28, ES-29, and ES-30 were created in response to the recent Hopewell Wildfire which occurred in southeastern Berks County and was the largest wildfire documented in Berks County.

ES-26: Increase the number of municipal firefighters trained in wildland fire fighting. Encourage municipal firefighters to complete the "Basic Wildland Firefighter" (PA-130) and "Introduction to Wildland Fire Behavior" (S-190) training courses, which are recommended by PA DCNR.

ES-27: Ensure municipal volunteer fire departments purchase the appropriate wildland firefighting equipment, including approved flame-resistant "natural fiber" jackets/gloves and appropriate wildland fire fighting helmets.

ES-28: Encourage wildland firefighting trained personnel to maintain reflective labels on their helmets and jackets to clearly identify their affiliation.

ES-29: Encourage emergency service providers to pursue grant opportunities to procure additional All-Terrain Vehicles (ATVs) or Utility-Terrain Vehicles (UTVs) for use in fighting wildland fires.

ES-30: Ensure existing and new residential developments located in the wildland/urban interface maintain viable transportation access for emergency service providers in the event of a wildfire.

A special coordination meeting was completed with Berks County DES on July 9, 2012, to identify any additional mitigation measures. The County indicated that ES-31 should be included in the updated plan.

ES-31: Berks County DES should continue coordination with regional water authorities to maintain adequate water supply for emergency preparedness.

In addition, both ES-32 and ES-33 were developed as part of the Mitigation Steering Committee meetings. ES-32 was derived from the October 31, 2011, snowfall which resulted in an above-average number of downed trees. Some parts of Berks County experienced power outages for nearly a week and, in some cases, longer. Members of the Mitigation Steering Committee confirmed the current technology used with the telecommunication system allows for only an eight-hour surplus of backup energy unless the utility systems have a built-in generator. Recommendations provided by the BCPC indicated that the County should consider the effects of natural disasters on the County's transportation routes as defined in ES-33. ES-32 and ES-33 are described below.

ES-32: Ensure the telecommunication companies have adequate on-site power to ensure ongoing communications during power outages.

ES-33: Berks County will coordinate with PennDOT Engineering District 5-0 regarding the identification of alternative detour evacuation routes to be developed on a multi-municipal basis.

Berks County DES is also in the process of updating its emergency response radio system to the 800 megahertz (MHz) digital radio system. FEMA's goal, as defined in the National Response Framework, is to implement the 800 MHz digital radio project as a universal means of communication between corresponding emergency officials. As such, Berks County DES is following the guidelines spelled out in the National Incident Management System (NIMS) to implement this project. Berks County DES believes the infrastructure will be in-place during 2014, therefore allowing the 800 MHz digital radio system to be implemented throughout Berks County.

6.3.2.7 2017 Plan Update Mitigation Measures

Mitigation Measures ES-34, ES-35 and ES-36 were adapted from the FEMA Mitigation Ideas (2013) resource and agreed upon at a Mitigation Steering Committee meeting.

ES-34: Ensure social vulnerable populations are adequately protected from the impacts of extreme temperatures such as organizing outreach to vulnerable populations, including establishing and promoting accessible heating and cooling centers in the community.

ES-35: Adopt a post disaster recovery ordinance based on a plan to regulate repair activity, generally depending on property location.

ES-36: Incorporate procedures for tracking high water marks following a flood into emergency response plans.

A special coordination meeting was completed with Berks County DES on September 19, 2017, to identify any additional mitigation measures. The County indicated that ES-37 should be included in the updated plan.

ES-37: Maintain and promote the County's Smart911 service that allows residents to create a safety profile for their households that they desire 9-1-1 and first responders to have in the event of an emergency.

6.3.2.8 2023 Plan Update Mitigation Measures

No new emergency services mitigation measures were added to the plan during the 2023 update. During the 2023 plan update, ES-34 was edited to include "social" before "vulnerable populations."

6.3.3 Property Protection

Property protection (PP) measures are used to minimize an existing structure's vulnerability to a known hazard rather than trying to modify or control the hazard itself. PP 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 PP measure typically requires acquisition of a local building permit and associated coordination with the local building, zoning, planning, and/or code enforcement office. PP measures include the following:

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

Implementation of PP 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 4.4.3) 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 PP 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 BCAs conducted for the 13 representative floodplain structures considered alternative PP 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 BCA results for the 13 representative floodplain structures is shown in Tables 6-1 and 6-2. The complete results (including supporting documentation) of the BCAs are included in the appendices. These benefit-cost ratios were used to assist in the identification of an appropriate PP 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 PP measure were then used to develop a guide to identifying and selecting an appropriate PP measure. This guide (see Table 6-3) 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 PP 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 PP measures. Additional information on PP 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 6-1
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 6-2
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

TABLE 6-3
BERKS COUNTY PROPERTY PROTECTION GUIDE

100-YEAR FLOOD IMPACT	TYPE OF STRUCTURE							
	RESIDENTIAL						COMMERCIAL [1]	INDUSTRIAL [1]
	1- TO 2-STORY WOOD FRAME			1- TO 2-STORY MASONRY				
	WITH BASEMENT	SLAB-ON-GRADE	CRAWL SPACE	WITH BASEMENT	SLAB-ON-GRADE	CRAWL SPACE		
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
0-2 Feet 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	Acquisition [2]
2-8 Feet in Basement	Wet Floodproofing [4]	N/A	N/A	Wet Floodproofing [4]	N/A	N/A	N/A	N/A
<1 Foot 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 Feet 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 Feet 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 Feet	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.

6.3.3.1 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.

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 6-4, the cost of moving a 1,000-square-foot building can range from $29 to $96 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 6-4
RELOCATION COST GUIDE

Construction Type	Existing Foundation	Retrofit	Relative Cost
Frame	Crawlspace, or open foundation	Relocate existing home and install the home on a new foundation at the new site, hook up utilities, and restore the old site	Lowest
Frame with masonry veneer			
Load bearing masonry			
Frame	Basement		
Frame with masonry veneer			
Load bearing masonry			
Frame	Slab-on-grade		
Frame with masonry veneer			
Load bearing masonry			Highest

Source: FEMA P-312, 3rd Edition/June 2014
a per square foot of building footprint
b for frame building with masonry veneer, add 10%

It should be noted that the costs shown in Table 6-4 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 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 6-3.

6.3.3.2 Elevation

Raising a building above the flood level (i.e., elevation) is the best on-site property protection method (see Figures 6-1 through 6-4). 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. 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 6-5 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 6-5, 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.

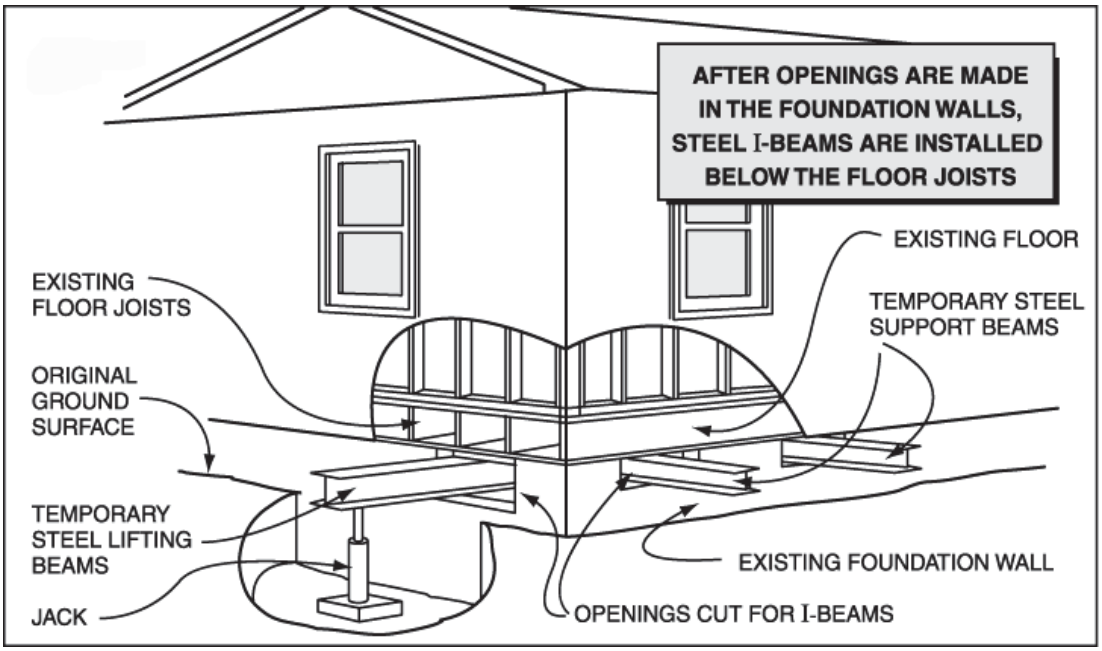


FIGURE 6-1
STEEL I-BEAMS AND JACKS ARE INSTALLED IN PREPARATION FOR LIFTING THE HOUSE

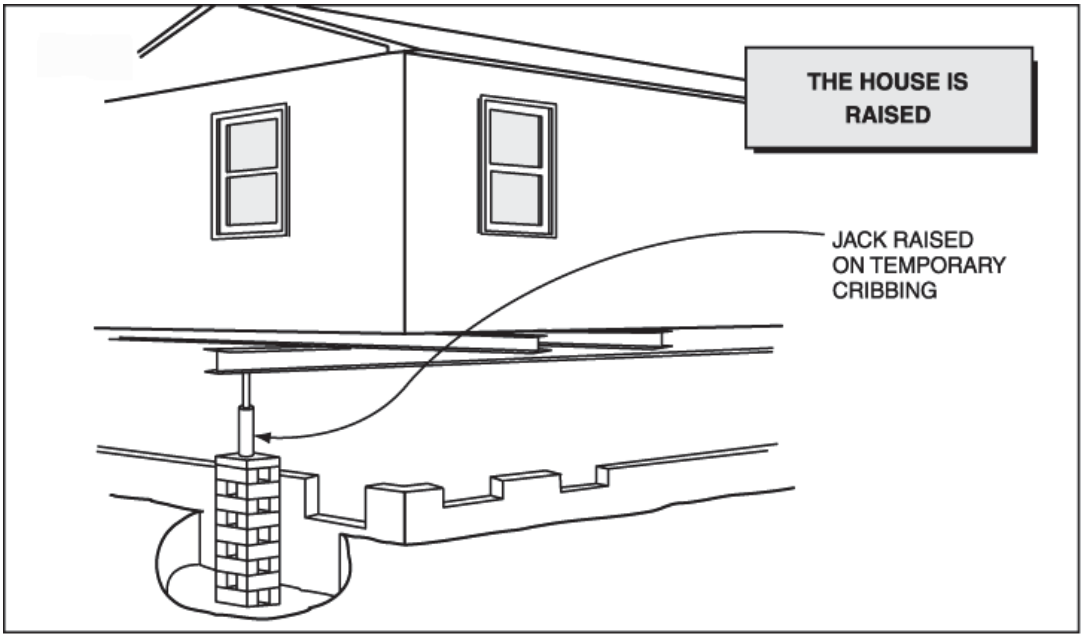


FIGURE 6-2
THE HOUSE, SUPPORTED ON THE I-BEAMS, IS RAISED ON THE JACKS

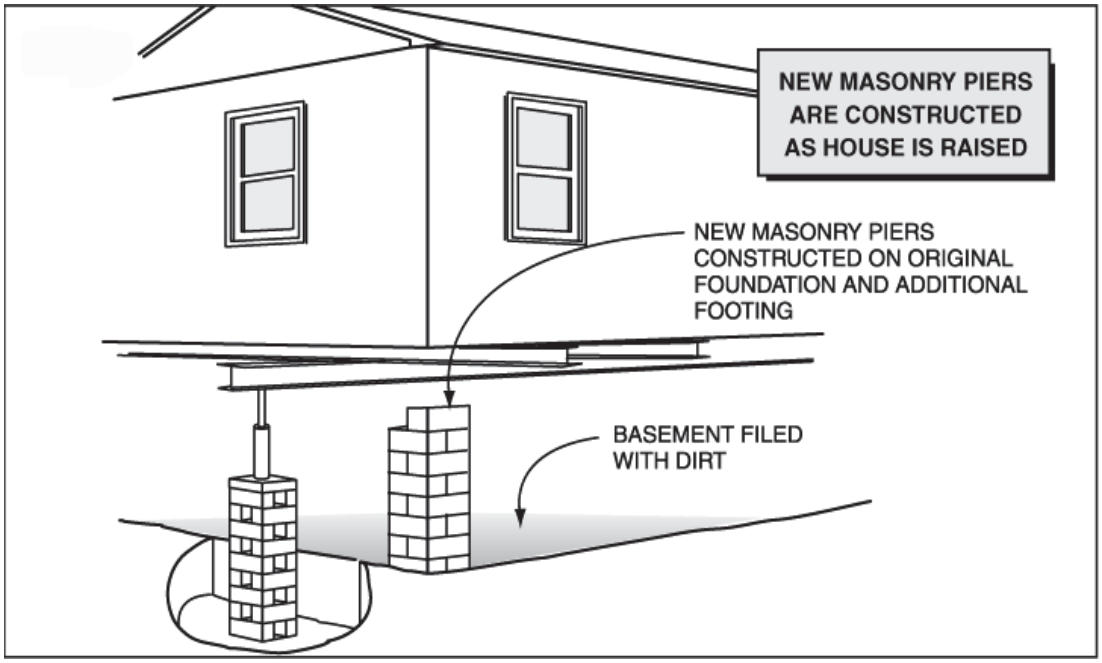


FIGURE 6-3
NEW MASONRY PIERS ARE CONSTRUCTED TO SUPPORT THE HOUSE, AND THE BASEMENT IS FILLED WITH DIRT

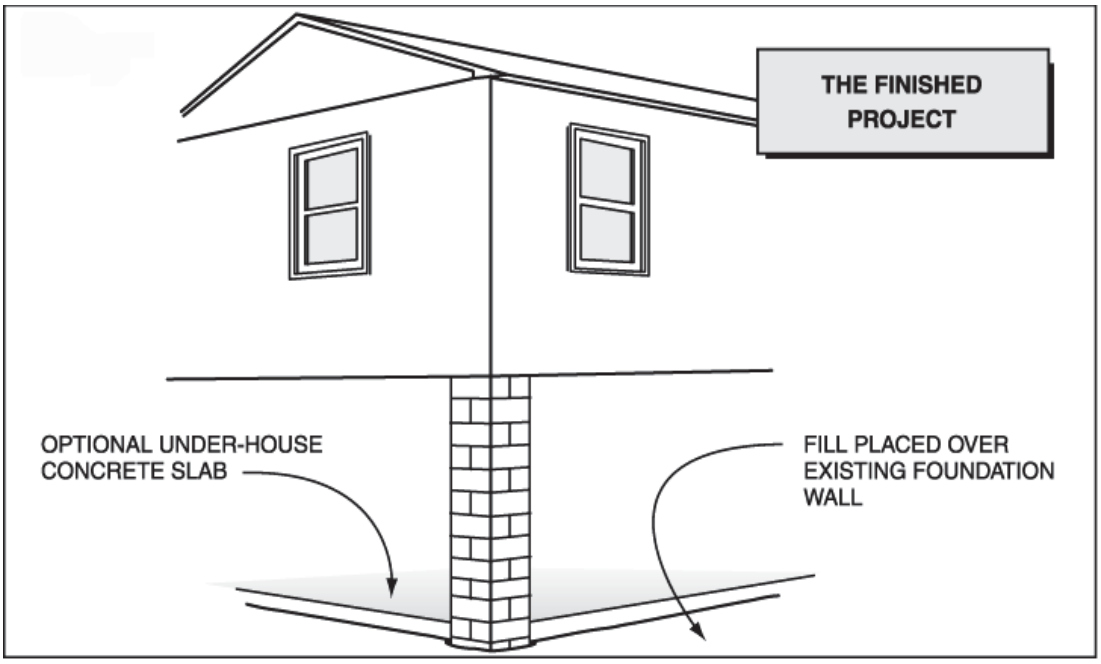


FIGURE 6-4
WHEN THE HOUSE HAS BEEN RAISED TO THE DESIRED HEIGHT, THE NEW MASONRY PIERS ARE COMPLETED

TABLE 6-5
ELEVATION COST GUIDE

CONSTRUCTION TYPE	EXISTING FOUNDATION	RETROFIT	RELATIVE COST
Frame	Basement, crawlspace, or open foundation	Elevate on continuous foundation walls or open foundation	Lowest
Frame with masonry veneer		Elevate on continuous foundation walls or open foundation	
Loadbearing masonry		Extend existing walls and create elevated living area	
Frame	Slab-on-grade	Elevate on continuous foundation walls or open foundation	Highest
Frame with masonry veneer		Elevate on continuous foundation walls or open foundation	
Frame with masonry veneer		Elevate on continuous foundation walls or open foundation	

Source: FEMA P-312, 3rd Edition/June 2014

Relative costs associated with elevating a structure indicate that a frame structure built with a basement, crawlspace, or open foundation would be less expensive than a frame structure built with a slab-on-grade as defined in Table 6-5.

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 ten-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 PP Hazard Mitigation Measure for potential implementation.

PP-2: Encourage the elevation of known flood-prone structures in accordance with the general guidelines of Table 6-3.

6.3.3.3 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.

6.3.3.3.1 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 6-5).

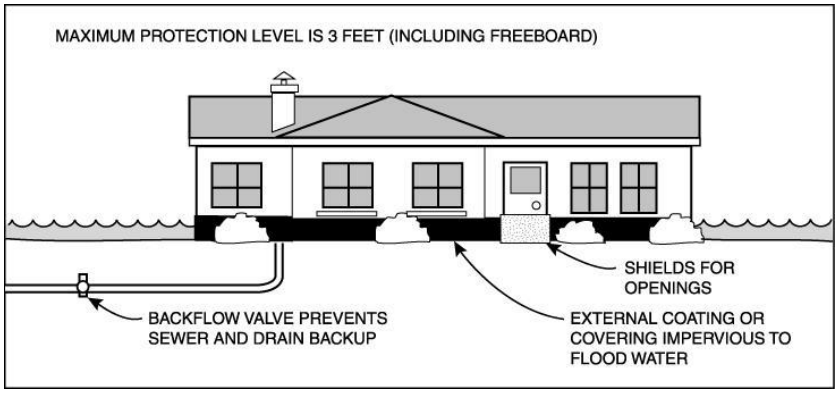


FIGURE 6-5
A TYPICAL DRY FLOODPROOFED HOUSE

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 6-6 provides cost information for some typical dry floodproofing activities.

TABLE 6-6
DRY FLOODPROOFING COST GUIDE

Component	Height of Dry Floodproofing	Relative Cost
Waterproof Membrane (above grade)[1]	3 Feet	Lowest ↓ Highest
Asphalt (two coats on foundation up to 2 feet below grade)[1]		
Sprayed-on Cement (above grade)[1]		
Wood Flood Shield		Lowest ↓ Highest
Metal Flood Shield		

[1] Cement, asphalt, and membrane are alternative sealant methods.

Source: FEMA P-312, 3rd Edition/June 2014

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 PP Hazard Mitigation Measure for potential implementation.

PP-3: Encourage dry floodproofing of known flood-prone structures in accordance with the general guidelines of Table 6-3.

6.3.3.3.2 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 6-6).

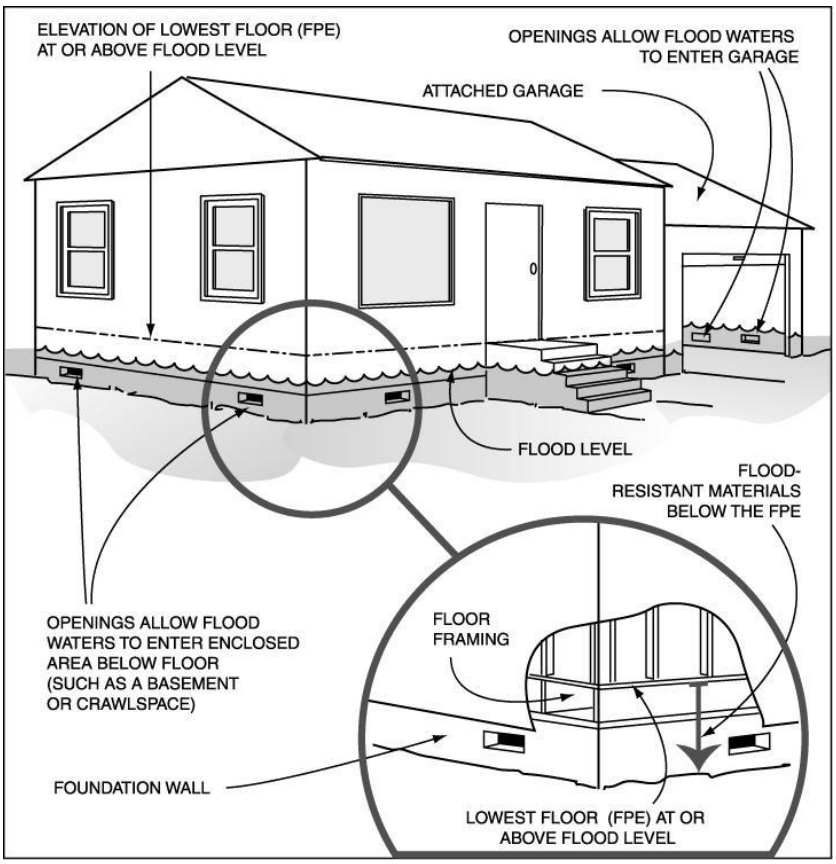


FIGURE 6-6
A TYPICAL WET FLOODPROOFED HOUSE

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.

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 6-6). 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 6-7 provides cost information for wet floodproofing to various heights.

TABLE 6-7
WET FLOODPROOFING COST GUIDE

Construction Type	Existing Foundation	Retrofit	Relative Cost
Frame, frame with masonry veneer, or loadbearing masonry	Crawlspace	Wet floodproof crawlspace to a height of 2 ft to 4 ft above LAG	Lowest ↓
	Basement	Wet floodproof unfinished basement to a height of 2 ft to 4 ft above the basement floor	
	Basement	Wet floodproof unfinished basement to a height of 8 ft above the basement floor	Highest

LAG = Lowest Adjacent Grade

Source: FEMA 259, January 2012

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 2½-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 PP Hazard Mitigation Measures for potential implementation.

PP-4: Encourage wet floodproofing of known flood-prone structures in accordance with the general guidelines of Table 6-3.

PP-5: Encourage the anchoring of fuel tanks located in flood-prone 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 flood-prone.

6.3.3.4 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 4-3, only one of Berks County's 72 municipalities (Lyons Borough) does not participate in the NFIP. As of November 2022, there were a total of 874 flood insurance policies in force in Berks County covering in excess of $160 million in personal property. Table 4-8 indicates that, as of November 2022, Berks County residents have submitted a total of 1,228 flood insurance claims and have received nearly $19 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 4-5 indicates that there are over 7,419 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 874 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 and Penn State Extension, nearly $400 million has been paid to farmers for losses in the past ten years (2010-2019). Drought is the largest cause of loss in agronomic crops (45%), followed by excess moisture (32%). 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 PP 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.

6.3.3.5 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 (i.e., 50 to 100 feet) of a building, 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 4-3), the Mitigation Steering Committee identified the following PP 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.

6.3.3.6 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 PP 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.

6.3.3.7 2012 Plan Update Mitigation Measures

Since the completion of the 2007 Hazard Vulnerability Assessment and Mitigation Plan, radon was identified as a known hazard that should be included according to FEMA. As such, the Mitigation Steering Committee recommended that mitigation measures should be developed to address radon in the updated Hazard Mitigation Plan. The new PP-13 and PP-14 were created to accommodate this request and read as follows:

PP-13: Investigate radon abatement options for minimizing radon occurrences in basements or crawlspaces and encourage periodic radon testing after installation of selected abatement options.

PP-14: Investigate PA DEP grant opportunities for municipalities to procure radon testing equipment for distribution in residential testing.

6.3.3.8 2017 Plan Update Mitigation Measures

Mitigation Measures PP-15, PP-16, PP-17, PP-18, and PP-19 were adapted from the FEMA Mitigation Ideas (2013) resource and agreed upon at a Mitigation Steering Committee meeting.

PP-15: Remove existing buildings and infrastructure from erosion hazard areas, landslide hazard areas and subsidence hazard areas.

PP-16: Stabilize erosion hazard areas by preventing erosion with proper bank stabilization, sloping or grading techniques, planting vegetation on slopes, terracing hillsides, or installing riprap boulders or geotextile fabric when updating or replacing foundations.

PP-17: Encourage or consider retrofitting buildings to minimize hail damage as normal routine maintenance:

- **Structural bracing, shutters, laminated glass in window panes, and hail-resistant roof coverings or flashing in building design;**
- **Improve roof sheathing;**
- **Installing hail-resistant roofing and siding**

PP-18: Install and maintain appropriate protection to critical electronic equipment from damage resulting from fluctuations in the power grid.

PP-19: Conduct regular maintenance for drainage systems and flood control systems.

6.3.3.9 2023 Plan Update Mitigation Measures

No new property protection mitigation measures were added to the plan during the 2023 update. Additionally, no revisions were made to any property protection measures during the 2023 update.

6.3.4 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)
- Maintain dam integrity throughout Berks County to protect resident lives through dam rehabilitation and/or removal dams (High Priority)
- Continue to work with dam owners/operators in the planning process (High Priority)

- Consider the viability of constructing additional flood control projects throughout the County (Low Priority)

- Implement flood protection measures such as berms and floodwalls within identified inundation areas and flood zones (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, Berks County DES 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 Berks County DES, 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 appendices. Reference is made to these Structural Project Identification Forms throughout this section of the Plan.

6.3.4.1 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-1970s. The primary function of the Blue Marsh Dam is to control floodflows along Tulpehocken Creek and the 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 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 appendices.

6.3.4.2 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 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 appendices to minimize local flooding impacts.

6.3.4.3 Stormwater Drainage Improvements

Effective collection and conveyance of stormwater runoff are 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 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 SLD regulations and the subsequent construction of stormwater retention/detention facilities help to control surface water flows from new developments, but existing problems still occur. As such, improving/upgrading existing stormwater drainage systems can significantly aid in minimized localized flooding problems.

Analysis of the Structural Project Identification Forms included in the appendices reveals a number of potential stormwater 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 appendices.

6.3.4.4 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 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 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.

6.3.4.5 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. 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.

6.3.4.6 Sinkhole Abatement

As previously mentioned, a large portion of the County (see Figure 4-2) 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 for structurally abating surface-exposed sinkhole features that pose an identifiable threat to the general public.

6.3.4.7 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 firefighting 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 6-7) 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.

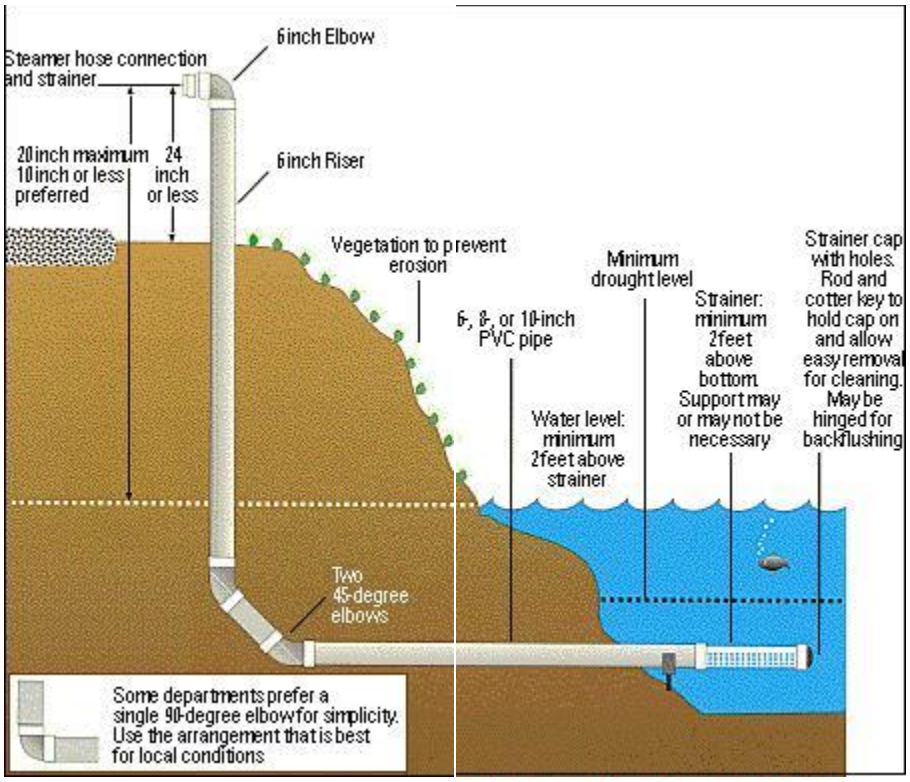


FIGURE 6-7
A TYPICAL DRY HYDRANT

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 firefighting 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.

6.3.4.8 2012 Updated Mitigation Measures

Mitigation Steering Committee members reviewed the structural project hazard mitigation measures and recommended a revision for SP-8 regarding sinkhole abatement. Members of the Committee believed that establishing mandatory timeframes is not feasible for municipal entities to complete for their structural abatement of surface-exposed sinkhole features. Within Section 6.3.4.6, SP-8 was revised to remove the text “and establish mandatory timeframes” for sinkhole abatement. In addition, one new structural project mitigation measure was identified.

SP-11: Recommend future Hazard Vulnerability Assessment and Mitigation Plan Updates review and document all flood-control projects. Review of PALs should be documented as well.

6.3.4.9 2017 Updated Mitigation Measures

Mitigation Steering Committee members did not identify any new structural project hazard mitigation measures as part of the Hazard Mitigation Plan Update. SP-12 was added at the request of the Berks County Department of Emergency Services based on a recent inspection of the Trout Run Dam and spillway.

SP-12: Recommend Boyertown Borough seek grant opportunities for spillway improvements of the Trout Run Dam. The spillway is considered to be inadequate, according to PA DEP Dam Safety, and is capable of passing only 59% of the

required spillway design. The Trout Run Dam improvements have been completed as of 2022, SP-12 has been removed.

6.3.4.10 2023 Plan Update Mitigation Measures

During the 2023 plan update, it was determined that SP-12 will be removed given the Trout Run Dam improvements have been completed by the Borough of Boyertown. No new structural projects mitigation measures were added during the 2023 plan update.

6.3.4.11 2024 Plan Amendment Mitigation Measures

Two new structural projects mitigation measures were added during a 2024 plan amendment for high hazard dams.

SP-13: In conjunction with PA DEP, the Reading Water Authority will conduct scoping to develop a plan for replacement of the Ontelaunee Dam with a new structure that will meet probable maximum precipitation (PMP) levels.

SP-14: In conjunction with PA DEP, the Reading Water Authority will replace the Ontelaunee Dam with a new structure that will meet PMP levels.

6.3.5 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 Nature, BCCD, 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 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 BMPs 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)

6.3.5.1 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, it 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 PMs) but can also be accomplished through property acquisition and easement. As such, the Mitigation Steering Committee identified the following 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 Conservation District, 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.

6.3.5.2 Wetland Protection

Wetlands, as defined by 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, United States Fish and Wildlife Service, and U.S. EPA. 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 NR 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. Wetland educational materials have been developed through Berks Nature, the MS4 Steering Committee, BCPC, and BCCD and will continue to be updated in the future.

6.3.5.3 Identification and Implementation of 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.

Fortunate for Berks County is the fact that the Conservation District has five erosion and sedimentation control technicians as of July 2022 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 NR 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.

6.3.5.4 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 PA DEP to determine current water withdrawal and use on an annual basis to help analyze water use and future needs. Similarly, the 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 2030 Update, completed in January of 2020, 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. During the CZIP program at the county, many municipalities adopted well head protection zones. Additionally, through the County Sourcewater protection program, a GIS database was created to use during BCPC SLD reviews to alert public drinking water suppliers that a PSOC was being proposed in their sourcewater protection zones. 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 NR 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. The BCPC prepared a Sewer and Water System Regionalization Study that includes water resources management. The BCPC will continue to update this study in the future.

6.3.5.5 2012 Updated Mitigation Measures

The Mitigation Steering Committee reviewed the natural resource mitigation measures and did not request any specific changes. As such, the existing natural resource mitigation measures identified in the 2007 plan will be maintained in the updated 2012 plan.

6.3.5.6 2017 Plan Update Mitigation Measures

Mitigation Measure NR-8 was adapted from the FEMA Mitigation Ideas (2013) resource and agreed upon at a Mitigation Steering Committee meeting.

NR-8: Stabilize erosion hazard areas.

6.3.5.7 2023 Plan Update Mitigation Measures

No new natural resources mitigation measures were added during the 2023 plan update; however, NR-5 and NR-7 were revised.

6.3.6 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)

6.3.6.1 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 FIRMs 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 FIRMs via FEMA's Flood Map Modernization Program to include the expansion of previously unmapped areas and additional BFEs. Deleted at the request of the Mitigation Steering Committee.

PI-2: Municipalities should store in an easily accessible location and make available for public inspection their community's FIRMs and associated FIS. Maintain what is already being done by the county.

6.3.6.2 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 website (http://www.fema.gov) is not only user-friendly, it 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 PI Hazard Mitigation Measures to be implemented within the County.

PI-3: Maintain natural hazard risk assessment and mitigation publications/materials found on the Berks County DES website 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.

6.3.6.3 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
- website 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 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.

6.3.6.4 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 PI Hazard Mitigation Measure to be implemented within the County.

PI-11: Coordinate with FEMA, PEMA, PA DCED, NWS, the BCCD, Berks Nature, MS4 Steering Committee and any other appropriate entities on developing and implementing a natural hazard awareness curriculum in local schools.

6.3.6.5 2012 Updated Mitigation Measures

The Mitigation Steering Committee agreed that PI-1 was no longer applicable because Berks County adopted the July 2012 updated FEMA 100-year floodplain mapping as its current effective floodplain mapping. Therefore, PI-1 is no longer applicable. In addition, one new public information mitigation measure (PI-12) was created. The new PI-12 will require future updates to

the Hazard Mitigation Plan to inventory public participation on the Berks County DES website. Table 6-8 documents the details of the new PI-12 mitigation measure.

PI-12: Monitor the Berks County DES website to inventory public participation of future Berks County Hazard Vulnerability Assessment and Mitigation Plan Updates.

TABLE 6-8
MUNICIPAL HAZARD MITIGATION ACTION PLAN

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	POTENTIAL FUNDING SOURCE*	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	DCED			
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	DCED			
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	N/A			
PM-4	Continue to maintain and update the County GIS structure layer to better define hazard-prone structures.	H	N/A			
PM-5	As 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	DCED			
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 emergency management coordinators and/or emergency personnel.	H	DCED			
PM-7	Enforce the minimum building standards of the Pennsylvania UCC and/or consider the potential adoption of more stringent building standards to ensure hazard-resistant construction.	H	N/A			
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	N/A			
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. In the absence of a County Floodplain Management Coordinator, Berks County should appoint a temporary Coordinator or rehire a new, permanent County Floodplain Management Coordinator. PM-9 was removed at the request of Berks County DES.	N/A	N/A			
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	N/A			

TABLE 6-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	POTENTIAL FUNDING SOURCE*	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
PM-11	If funding should become available through the PA DEP's Act 167 Stormwater Management Program, pursue the preparation of a countywide Act 167 Stormwater Management Plan	L	DEP Stormwater Management			
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	N/A			
PM-13	Revise existing zoning and/or SLD 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 SLD projects in known land subsidence hazard areas.	H	N/A			
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.	M	FMAGP			
PM-15	Municipalities with identified wildfire potential should enroll in the Pennsylvania Firewise Communities Program.	L	N/A			
PM-16	Adopt an ordinance to ban open burning as conditions warrant in wildfire hazard areas or throughout the municipality.	M	N/A			
PM-17	Identify local drought indicators and establish a regular schedule to monitor and report conditions.	M	N/A			
PM-18	Develop agreements for secondary water sources that may be used during drought conditions.	H	N/A			
PM-19	Require municipalities to adopt updates to UCCs.	M	N/A			
PM-20	Municipalities shall designate a Floodplain Administrator to comply with provisions of the National Flood Insurance Program Section 60.3 (d) and the Pennsylvania Floodplain Management Act (Act 166-1978).	H	N/A			
PM-21	PM – 21: The municipal separate storm sewer system (MS4) requirements must be adhered to for municipalities located in "urban settings" as designated per the 1990 and 2000 census. According to DEP, municipalities located within the MS4 designation must follow the Minimum Control Measures (MCMs) as described below: • Public education and outreach • Public involvement and participation • Illicit discharge detection and elimination • Construction site runoff control • Post-construction stormwater management in new development and redevelopment • Pollution prevention and good housekeeping for municipal operations and maintenance	H	DEP			

TABLE 6-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	POTENTIAL FUNDING SOURCE*	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 Website - http://www.berksdes.com) during non-emergencies, but act as an extension of the Emergency Alert System in times of pending disaster and during a disaster. Additional real-time Web resources include http://www.facbook.com/BerksCountyDES and Twitter@BerksDES	H	FEMA-HMGP			
ES-2	Participate in the NWS's StormReady Program, a nationwide program that helps communities develop plans to handle all types of severe weather. Berks County became StormReady on May 31, 2018 and is certified through 2025.	M	N/A			
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	N/A			
ES-4	Install a NOAA weather radio transmitter/repeater in Berks County to improve signal strength and quality.	H	FEMA-PAGP			
ES-5	Coordinate with the USGS, local watershed organizations, and/or the BCCD to increase the number of USGS 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	DEP Stormwater			
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.).	L	FEMA-PAGP			
ES-7	Provide EMCs with technical assistance for their high bandwidth wireless service and/or alphanumeric pagers as a means of maintaining the County's warning dissemination program.	H	FEMA and PEMA			
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	N/A			
ES-9	Ensure that a planned, coordinated, and effective public warning dissemination program such as Roam Secure Alert Network (RSAN) exists and is maintained at the local level.	H	N/A			
ES-10	Municipalities to develop and implement a reverse 9-1-1 system; also known as Interactive Communication Notification System.	L	FEMA PAGP			
ES-11	Respond to hazards with actions that are consistent with the local EOP.	H	N/A			
ES-12	Conduct hazard response practice drills and emergency management training exercises on an annual basis.	H	N/A			
ES-13	Create locally coordinated snow routes in municipalities where snow removal is limited or difficult during major winter storm events.	H	N/A			

TABLE 6-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	POTENTIAL FUNDING SOURCE*	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
ES-14	Review grant opportunities to implement a system similar to PennDOT's RWIS (Road and Weather Information System) completed on Interstate - 78 that will monitor major arteries in Berks County and report this information to the County's website.	H	DEP and PENNVEST			
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 website.	M	PennDOT			
ES-16	Provide generators for every municipal EOC and possibly those critical facilities that do not currently have one. ES-16 was removed at the request of Berks County DES.	N/A	N/A			
ES-17	Provide and maintain battery backup systems for traffic control systems throughout the County.	M	N/A			
ES-18	Ensure the Limerick Power Plant operator maintains and updates evacuation response equipment.	H	N/A			
ES-19	Conduct routine inspections, regular maintenance, and annual tests on all emergency response equipment.	H	N/A			
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 – Berks County DES should consider partnering with the owners/operators of critical facilities to provide adequate planning and protection.	H	PEMA			
ES-21	Develop and distribute potential health and safety implications of various natural hazard events on the Berks County DES website: http://www.berksdes.com and through local press releases.	M	N/A			
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.	H	DEP			
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.	M	CDBG			
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	DCED, USACE Floodplain Manage Services, HUD-CDBG-DRI			
ES-25	Continue to maintain/update the Berks County DES Website that contains information related to the Hazard Mitigation 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" website on the Berks County DES Website (https://www.disasterhelp.gov/portal/jhtml/index.jhtml).	H	DEP and PennVEST			

TABLE 6-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	POTENTIAL FUNDING SOURCE*	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
ES-26	Berks County DES should continue coordination with the regional area water authorities to maintain an adequate water supply for emergency preparedness.	M	N/A			
ES-27	Increase the number of municipal firefighters trained in wildland firefighting. Encourage municipal firefighters to complete "Basic Wildland Firefighter (PA-130) and "Introduction to Wildland Fire Behavior" (S-190) training courses which is recommended by PA DCNR.	M	FMAGP			
ES-28	Ensure municipal volunteer fire departments purchase the appropriate wildland firefighting equipment including: Approved flame resistant "natural fiber" jackets/gloves and appropriate wildland firefighting helmets.	M	FMAGP			
ES-29	Encourage wildland firefighting trained personnel to maintain reflective labels on their helmets and jackets to clearly identify their affiliation.	L	N/A			
ES-30	Encourage emergency service providers to pursue grant opportunities to procure additional All-Terrain Vehicles (ATVs) or Utility-Terrain Vehicles (UTVs) for use in fighting wildland fires.	H	DCNR C2P2			
ES-31	Ensure existing and new residential developments located in the wildland/urban interface maintain viable transportation access for emergency service providers in the event of a wildfire.	H	N/A			
ES-32	Ensure the telecommunication companies have adequate on-site power to ensure ongoing communications during power outages.	H	N/A			
ES-33	Berks County will coordinate with PennDOT Engineering District 5-0 on the identification of alternative detour evacuation routes to be developed on a multi-municipal basis.	H	N/A			
ES-34	Ensure social vulnerable populations are adequately protected from the impacts of extreme temperatures such as organizing outreach to vulnerable populations, including establishing and promoting accessible heating and cooling centers in the community.	L	DEP			
ES-35	Adopt a post disaster recovery ordinance based on a plan to regulate repair activity, generally depending on property location.	M	N/A			
ES-36	Incorporate procedures for tracking high water marks following a flood into emergency response plans.	L	N/A			
PP-1	Relocate and/or acquire known flood-prone structures in accordance with the general guidelines of Table 6-3.	M	DCED, FEMA			
PP-2	Encourage the elevation of known flood-prone structures in accordance with the general guidelines of Table 6-3.	M	FEMA			
PP-3	Encourage dry floodproofing of known flood-prone structures in accordance with the general guidelines of Table 6-3.	M	FEMA			

TABLE 6-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	POTENTIAL FUNDING SOURCE*	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 6-3.	L	FEMA			
PP-5	Encourage the anchoring of fuel tanks located in flood-prone 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	FEMA			
PP-6	Inventory historic assets within the county and verify whether wet floodproofing may be the most effective measures to protect those that are flood-prone.	M	PHMC			
PP-7	Encourage uninsured property owners in known flood hazard areas to purchase flood insurance through the NFIP.	L	N/A			
PP-8	Encourage farmers to visit their local FSA office to discuss the benefits of obtaining crop insurance.	L	N/A			
PP-9	Encourage uninsured property owners in known subsidence hazard areas to purchase sinkhole insurance as a supplement to their existing homeowner's policy.	L	N/A			
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	N/A			
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	N/A			
PP-12	Provide protection of critical Berks County records through emergency response planning or other appropriate measures.	M	N/A			
PP-13	Investigate radon abatement options for minimizing radon occurrence in basements or crawl spaces and encourage periodic radon testing after installation of selected abatement options.	L	DEP			
PP-14	Investigate PA DEP grant funding opportunities for municipalities to procure radon testing equipment for distribution in residential testing.	L	DEP			
PP-15	Remove existing buildings and infrastructure from erosion hazard areas, landslide hazard areas and subsidence hazard areas.	L	PAGP			
PP-16	Stabilize erosion hazard areas by preventing erosion with proper bank stabilization, sloping or grading techniques, planting vegetation on slopes, terracing hillsides, or installing riprap boulders or geotextile fabric when updating or replacing foundations.	L	DEP			

TABLE 6-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	POTENTIAL FUNDING SOURCE*	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
PP-17	Encourage or consider retrofitting buildings to minimize hail damage as normal routine maintenance: • Structural bracing, shutters, laminated glass in window panes, and hail-resistant roof coverings or flashing in building design; • Improve roof sheathing; • Installing hail-resistant roofing and siding	L	PAGP			
PP-18	Install and maintain appropriate protection to critical electronic equipment from damage resulting from fluctuations in the power grid.	L	PennVEST			
PP-19	Conduct regular maintenance for drainage systems and flood control systems.	H	PennVEST			
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 appendices.	M	USACE - FMS			
SP-2	Design and construct the bridge/culvert modification projects in accordance with the Structural Project Identification Forms found in the appendices to minimize local flooding impacts.	M	PennDOT			
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 appendices.	M	DEP			
SP-4	Design, permit, and construct channel modification projects in accordance with the Structural Project Identification Forms found in the appendices.	M	DEP			
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.	M	N/A			
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.	M	DCNR			
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	N/A			
SP-8	Require expert technical assistance for structurally abating surface-exposed sinkhole features that pose an identifiable threat to the general public.	H	N/A			
SP-9	Install easily accessible and reliable water supply dry hydrants at various bridge and culvert crossings of local streams and watercourses for emergency firefighting uses through coordination with local fire companies.	M	PennVEST			
SP-10	Consider the feasibility of establishing an emergency potable water supply source to offset potential shortages caused by extreme drought events.	M	DEP/PennVEST			

TABLE 6-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	POTENTIAL FUNDING SOURCE*	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
SP-11	Recommend future Hazard Vulnerability Assessment and Mitigation Plan Updates review and document all flood-control projects. Review of PALs should be documented as well.	M	FMAP			
SP-12	Recommend Boyertown Borough seek grant opportunities for spillway improvements of the Trout Run Dam. The spillway is considered to be inadequate, according to PA DEP Dam Safety, and is capable of passing only 59% of the required spillway design. The Trout Run Dam improvements have been completed as of 2022, SP-12 has been removed.	N/A	N/A			
SP-13	In conjunction with PA DEP, the Reading Water Authority will conduct scoping to develop a plan for the replacement of the Ontelaunee Dam with a new structure that will meet PMP levels.	H	HHPD			
SP-14	In conjunction with the PA DEP, the Reading Water Authority will replace the Ontelaunee Dam with a new structure that will meet the PMP levels.	H	HHPD			
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 Conservation District, and others.	M	DCED Funding			
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	DCNR/DEP Growing Greener			
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	DCNR/DEP Growing Greener			
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	DCNR/DEP Growing Greener			
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. Wetland educational materials have been developed through Berks Nature, the MS4 Steering Committee, BCPC, and BCCD and will continue to be updated in the future.	M	DEP			

TABLE 6-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	POTENTIAL FUNDING SOURCE*	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
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	N/A			
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. The BCPC prepared a Sewer and Water System Regionalization Study that includes water resources management. The BCPC will continue to update this study in the future.	M	DEP			
NR-8	Stabilize erosion hazard areas.	M	DEP and PennVEST			
PI-1	Coordinate with FEMA and the PA DCED regarding updating Berks County's FIRMs via FEMA's Flood Map Modernization Program to include the expansion of previously unmapped areas and additional BFEs. Deleted at the request of the Mitigation Steering Committee.	N/A	N/A			
PI-2	Municipalities should store in an easily accessible location and make available for public inspection, their community's FIRMs and associated FIS. Maintain what is already being done by the County.	M	N/A			
PI-3	Maintain natural hazard risk assessment and mitigation publications/materials found on the Berks County DES website at public libraries throughout the County for those who do not have access to the Internet.	M	N/A			
PI-4	Store in an easily accessible location and make available for public inspection, this hazard mitigation plan and available FEMA guidance documents.	H	N/A			
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	N/A			
PI-6	Develop and implement a post-disaster recovery and mitigation training program for local officials.	H	PEMA and FEMA			
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	DCED			
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	N/A			
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	FEMA			
PI-10	Develop floodplain management training at the local level for elected officials, EMC's, etc.	L	FEMA			

TABLE 6-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	POTENTIAL FUNDING SOURCE*	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
PI-11	Coordinate with FEMA, PEMA, PA DCED, NWS, the BCCD, Berks Nature, MS4 Steering Committee and any other appropriate entities on developing and implementing a natural hazard awareness curriculum in local schools.	L	FEMA			
PI-12	Monitor the Berks County DES website to inventory public participation of future Berks County Hazard Vulnerability Assessment and Mitigation Plan Updates.	M	N/A			
PI-13	Educate farmers about the various soil conservation programs available in the county.	L	USDA			
PI-14	Increase hazard education and risk awareness in general for the hazards that occur in Berks County.	L	FEMA			
PI-15	Encourage municipal participation in the hazard mitigation planning process.	H	N/A			
PI-16	Berks County DES to incorporate hazard mitigation training during its January coordination meetings with stakeholders. Berks County has incorporated the hazard mitigation trainings into their meetings as of January 2019, and coordination is ongoing.	H	N/A			

*Funding source descriptions can be found in section 6.4.1
NOTE: Primary responsibility for items with the shading has been assigned to entities other than municipal governments.

6.3.6.6 2017 Plan Update Mitigation Measures

Mitigation Measures PI-13 and PI-14 were adapted from the FEMA Mitigation Ideas (2013) resource and agreed upon at a Mitigation Steering Committee meeting. Mitigation Measures PI-15 and PI-16 resulted from discussions at a Mitigation Steering Committee Meeting.

PI-13: Educate farmers about the various soil conservation programs available in the county.

PI-14: Increase hazard education and risk awareness in general for the hazards that occur in Berks County.

PI-15: Encourage municipal participation in the hazard mitigation planning process.

PI-16: Berks County DES to incorporate hazard mitigation training during its January coordination meetings with stakeholders. Berks County has incorporated the hazard mitigation trainings into their meetings as of January 2019, and coordination is ongoing.

6.3.6.7 2023 Plan Update Mitigation Measures

No new public information mitigation measures were added during the 2023 plan update; however, PI-11 and PI-16 were revised.

6.4 MITIGATION ACTION PLAN

Table 6-8 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 Section 6.2), 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
- 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 6-8 is structured to allow each municipality to check off or indicate those projects that have been identified as being applicable to its particular jurisdiction (see Table 6-9, Multi-Jurisdictional Hazard Mitigation Strategy) 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.

6.4.1 Potential Funding Sources

FEMA's PDM and HMGP Programs 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% 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% 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 website (http://www.fema.gov/pre-disaster-mitigation-grant-program).

TABLE 6-9
MULTI-JURISDICTIONAL HAZARD MITIGATION STRATEGY

Municipality	Mitigation Measure																																																									
	PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	PM-8	PM-9	PM-10	PM-11	PM-12	PM-13	PM-14	PM-15	PM-16	PM-17	PM-18	PM-19	PM-20	PM-21	ES-1	ES-2	ES-3	ES-4	ES-5	ES-6	ES-7	ES-8	ES-9	ES-10	ES-11	ES-12	ES-13	ES-14	ES-15	ES-16	ES-17	ES-18	ES-19	ES-20	ES-21	ES-22	ES-23	ES-24	ES-25	ES-26	ES-27	ES-28	ES-29	ES-30	ES-31	ES-32	ES-33	ES-34	ES-35	ES-36	ES-37
Metro Planning District
Bern Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Cumru Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Kenhorst Borough	X	X			X	X	X	X	X	X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Laureldale Borough	X	X			X	X	X						X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X				X		X	X	X	X	X	X			X		X	
Leesport Borough	X	X			X	X	X	X		X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Lower Alsace Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Mohnton Borough	X	X			X	X	X	X	X	X				X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Mt Penn Borough	X	X			X	X	X						X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X				X		X	X	X	X	X	X			X		X	
Muhlenberg Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Ontelaunee Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Reading City	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Shillington Borough	X	X			X	X	X	X	X	X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Sinking Spring Borough	X	X			X	X	X	X	X	X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Spring Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
West Reading Borough	X	X			X	X	X	X	X	X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Wyomissing Borough	X	X			X	X	X	X	X	X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Hawk Mountain Planning District
Albany Township	X	X			X	X	X	X	X	X				X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Centerport Borough	X	X			X	X	X	X	X	X						X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Centre Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Fleetwood Borough	X	X			X	X	X	X		X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Greenwich Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Hamburg Borough	X	X			X	X	X	X	X	X						X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Kutztown Borough	X	X			X	X	X	X		X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Lenhartsville Borough	X	X			X	X	X	X	X	X				X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Lyons Borough	X	X			X	X	X						X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X				X										X		X	
Maidencreek Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Maxatawny Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Perry Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Richmond Township	X	X			X	X	X	X		X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Shoemakersville Borough	X	X			X	X	X	X	X	X						X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Tilden Township	X	X			X	X	X	X	X	X				X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Upper Bern Township	X	X			X	X	X	X	X	X				X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Upper Tulpehocken Township	X	X			X	X	X	X		X				X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Windsor Township	X	X			X	X	X	X		X				X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Oley Hills Planning District
Alsace Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Bally Borough	X	X			X	X	X	X	X	X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Bechtelsville Borough	X	X			X	X	X	X		X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Boyertown Borough					X	X	X	X	X	X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Colebrookdale Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
District Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Earl Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Hereford Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Longswamp Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Oley Township	X	X			X	X	X	X		X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Pike Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Rockland Township	X	X			X	X	X	X		X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Ruscombmanor Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Topton Borough	X	X			X	X	X	X	X	X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Washington Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Tulpehocken Planning District
Bernville Borough	X	X			X	X	X	X	X	X						X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Bethel Township	X	X			X	X	X	X		X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Heidelberg Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Jefferson Township	X	X			X	X	X	X		X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Lower Heidelberg Township	X	X			X	X	X	X		X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Marion Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
North Heidelberg Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Penn Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Robesonia Borough	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
South Heidelberg Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Tulpehocken Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Wernersville Borough	X	X			X	X	X	X	X	X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Womelsdorf Borough	X	X			X	X	X	X	X	X			X			X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X										X		X	
Southern Hills Planning District
AmityTownship	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Birdsboro Borough	X	X			X	X	X	X	X	X				X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Brecknock Township	X	X			X	X	X	X	X	X				X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Caernarvon Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Douglass Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Exeter Township	X	s			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
New Morgan Borough	X	X			X	X	X	X	X	X				X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Robeson Township	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
St Lawrence Borough	X	X			X	X	X	X	X	X			X	X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Union Township	X	X			X	X	X	X	X	X				X	X	X	X	X	X	X	X		X						X	X		X	X	X					X	X	X			X	X		X	X	X	X	X	X			X		X	
Other Jurisdiction
Berks County DES			X	X								X		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	X
Berks County Planning	X	X	X	X	X	X		X		X	X		X														X																															
Berks County Conservation District								X	X	X																X	X																	X														
Other Berks County Entity												X															X								X	X	X	X	X				X															
Other Public/Private Dam Owners												X																																														
PA DCNR														X	X																																											
PA DEP																																																										
PennDOT																																			X	X		X	X				X											X				
PEMA/FEMA																													X				X						X	X			X		X													
U.S. Army Corps of Engineers												X																																														

Legend

Mitigation Measure	Status of Mitigation Measure	
Wildfire	Mitigation Measure identified in 2007, 2012, 2017 or 2023 Plan	X
Drought	Measure has been completed, no further action required	
Flooding	Measure has been completed, but should continue implementing	
Severe Storms	Measure has not been completed	
Dam Failure	New Measure	
Subsidence	Measure No Longer Applicable	
Multi-Hazard		
Radon		
Earthquakes		
Landslides		

TABLE 6-9
MULTI-JURISDICTIONAL HAZARD MITIGATION STRATEGY

Municipality	Mitigation Measure																																																					
	PP-1	PP-2	PP-3	PP-4	PP-5	PP-6	PP-7	PP-8	PP-9	PP-10	PP-11	PP-12	PP-13	PP-14	PP-15	PP-16	PP-17	PP-18	PP-19	SP-1	SP-2	SP-3	SP-4	SP-5	SP-6	SP-7	SP-8	SP-9	SP-10	SP-11	SP-12	NR-1	NR-2	NR-3	NR-4	NR-5	NR-6	NR-7	NR-8	PI-1	PI-2	PI-3	PI-4	PI-5	PI-6	PI-7	PI-8	PI-9	PI-10	PI-11	PI-12	PI-13	PI-14	PI-15	PI-16
Metro Planning District																																																							
Bern Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X			X		X	X	X	X		X			X	X	X	X	X			X		X		X					X				X	X		
Cumru Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X					X		X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Kenhorst Borough	X	X	X	X	X		X		X		X		X	X	X	X	X	X	X					X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Laureldale Borough									X	X			X	X	X	X	X	X	X					X		X	X					X		X	X	X			X				X									X	X		
Leesport Borough	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X					X	X	X	X		X			X	X	X	X	X			X		X		X					X				X	X		
Lower Alsace Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X					X		X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Mohnton Borough	X	X	X	X	X		X			X	X		X	X	X	X	X	X	X					X								X	X	X	X	X			X		X		X					X				X	X		
Mt Penn Borough									X	X			X	X	X	X	X	X	X			X	X	X		X	X		X			X		X	X	X			X				X									X	X		
Muhlenberg Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X					X		X	X		X			X	X	X	X	X			X		X		X					X				X	X		
Ontelaunee Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X					X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Reading City	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X					X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Shillington Borough	X	X	X	X	X		X		X		X		X	X	X	X	X	X	X					X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Sinking Spring Borough	X	X	X	X	X		X		X		X		X	X	X	X	X	X	X				X	X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Spring Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X		X	X		X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
West Reading Borough	X	X	X	X	X		X		X		X		X	X	X	X	X	X	X					X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Wyomissing Borough	X	X	X	X	X		X		X		X		X	X	X	X	X	X	X	X	X	X	X	X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Hawk Mountain Planning District																																																							
Albany Township	X	X	X	X	X		X			X	X		X	X	X	X	X	X	X					X	X			X				X	X	X	X	X			X		X		X					X				X	X		
Centerport Borough	X	X	X	X	X		X				X		X	X	X	X	X	X	X					X								X	X	X	X	X			X		X		X					X				X	X		
Centre Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X					X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Fleetwood Borough	X	X	X	X	X		X		X		X		X	X	X	X	X	X	X					X		X	X		X			X	X	X	X	X			X		X		X					X				X	X		
Greenwich Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X		X	X		X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Hamburg Borough	X	X	X	X	X		X				X		X	X	X	X	X	X	X			X							X			X	X	X	X	X			X		X		X					X				X	X		
Kutztown Borough	X	X	X	X	X		X		X		X		X	X	X	X	X	X	X			X	X	X		X	X		X			X	X	X	X	X			X		X		X					X				X	X		
Lenhartsville Borough	X	X	X	X	X		X			X	X		X	X	X	X	X	X	X					X								X	X	X	X	X			X		X		X					X				X	X		
Lyons Borough									X				X	X	X	X	X	X	X					X		X	X		X			X	X	X	X	X			X				X									X	X		
Maidencreek Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X		X		X	X	X	X	X	X	X			X		X	X	X			X		X		X					X				X	X		
Maxatawny Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X			X	X	X	X	X			X		X		X					X				X	X		
Perry Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X					X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Richmond Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X		X	X		X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Shoemakersville Borough	X	X	X	X	X		X				X		X	X	X	X	X	X	X					X					X			X	X	X	X	X			X		X		X					X				X	X		
Tilden Township	X	X	X	X	X		X			X	X		X	X	X	X	X	X	X		X	X		X	X			X				X	X	X	X	X			X		X		X					X				X	X		
Upper Bern Township	X	X	X	X	X		X			X	X		X	X	X	X	X	X	X					X	X			X				X	X	X	X	X			X		X		X					X				X	X		
Upper Tulpehocken Township	X	X	X	X	X		X			X	X		X	X	X	X	X	X	X					X	X			X				X	X	X	X	X			X		X		X					X				X	X		
Windsor Township	X	X	X	X	X		X			X	X		X	X	X	X	X	X	X					X	X			X				X	X	X	X	X			X		X		X					X				X	X		
Oley Hills Planning District																																																							
Alsace Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Bally Borough	X	X	X	X	X		X		X		X		X	X	X	X	X	X	X					X		X	X		X			X	X	X	X	X			X		X		X					X				X	X		
Bechtelsville Borough	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X					X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Boyertown Borough	X	X	X	X	X		X		X		X		X	X	X	X	X	X	X			X		X		X	X				X	X	X	X	X	X			X		X		X					X				X	X		
Colebrookdale Township	X	X	X	X	X		X		X	X	X		X	X	X	X	X	X	X		X	X	X	X		X	X					X	X	X	X	X			X		X		X					X				X	X		
District Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X						X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Earl Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X		X	X		X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Hereford Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Longswamp Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Oley Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X			X		X		X	X		X			X	X	X	X	X			X		X		X					X				X	X		
Pike Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X		X			X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Rockland Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Ruscombmanor Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X		X	X		X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Topton Borough	X	X	X	X	X	X	X		X		X		X	X	X	X	X	X	X					X		X	X		X			X	X	X	X	X			X		X		X					X				X	X		
Washington Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Tulpehocken Planning District																																																							
Bernville Borough	X	X	X	X	X	X	X				X		X	X	X	X	X	X	X					X					X			X	X	X	X	X			X		X		X					X				X	X		
Bethel Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Heidelberg Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Jefferson Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Lower Heidelberg Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X		X			X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Marion Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X		X	X					X	X	X	X	X			X		X		X					X				X	X		
North Heidelberg Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X	X			X	X	X	X	X			X		X		X					X				X	X		
Penn Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Robesonia Borough	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X		X	X		X			X	X	X	X	X			X		X		X					X				X	X		
South Heidelberg Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Tulpehocken Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X		X	X		X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Wernersville Borough	X	X	X	X	X	X	X		X		X		X	X	X	X	X	X	X					X		X	X		X			X	X	X	X	X			X		X		X					X				X	X		
Womelsdorf Borough	X	X	X	X	X	X	X		X		X		X	X	X	X	X	X	X			X		X		X	X		X			X	X	X	X	X			X		X		X					X				X	X		
Southern Hills Planning District																																																							
AmityTownship	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X		X	X		X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Birdsboro Borough	X	X	X	X	X	X	X			X	X		X	X	X	X	X	X	X			X		X								X	X	X	X	X			X		X		X					X				X	X		
Brecknock Township	X	X	X	X	X	X	X			X	X		X	X	X	X	X	X	X					X	X			X				X	X	X	X	X			X		X		X					X				X	X		
Caernarvon Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X		X	X		X			X	X	X	X	X			X		X		X					X				X	X		
Douglass Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
Exeter Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X		X	X		X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
New Morgan Borough	X	X	X	X	X	X	X			X	X		X	X	X	X	X	X	X					X	X			X				X	X	X	X	X			X		X		X					X				X	X		
Robeson Township	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X		X			X	X	X	X	X				X	X	X	X	X			X		X		X					X				X	X		
St Lawrence Borough	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X					X		X	X					X	X	X	X	X			X		X		X					X				X	X		
Union Township	X	X	X	X	X	X	X			X	X		X	X	X	X	X	X	X		X			X	X			X				X	X	X	X	X			X		X		X					X				X	X		
Other Jurisdiction																																																							
Berks County DES	X	X	X	X	X		X		X	X	X	X			X	X	X	X	X									X		X		X							X			X	X	X	X	X	X	X	X	X	X	X	X	X	X
Berks County Planning	X	X	X	X	X	X	X					X																				X	X	X	X	X		X			X		X						X						
Berks County Conservation District	X	X	X	X	X	X	X	X			X	X												X									X		X	X	X				X		X					X	X	X					
Other Berks County Entity							X		X		X	X												X					X			X	X	X	X							X	X			X	X								
Other Public/Private Dam Owners																																																							
PA DCNR									X	X															X																														
PA DEP																																			X																				
PennDOT																								X												X																			
PEMA/FEMA							X				X																																												
U.S. Army Corps of Engineers																																			X	X																			

Legend

Mitigation Measure
Wildfire
Drought
Flooding
Severe Storms
Dam Failure
Subsidence
Multi-Hazard
Radon
Earthquakes
Landslides

Status of Mitigation Measure	
Mitigation Measure identified in 2007, 2012, 2017 or 2023 Plan	X
Measure has been completed, no further action required	
Measure has been completed, but should continue implementing	
Measure has not been completed	
New Measure	
Measure No Longer Applicable	

FEMA's 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% of the total eligible costs. At least 25% of the total eligible costs must be provided by a non-federal source. Of this 25%, 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 website (http://www.fema.gov/flood-mitigation-assistance-program).

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, recover from their impact, and mitigate impacts 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 participating 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 website (http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit).

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/about-national-dam-safety-program).

FEMA's High Hazard Potential Dam Grant Program (HHPD) provides technical, planning, design and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams. High Hazard Potential is a classification standard for any dam whose

failure or mis-operation will cause loss of human life and significant property destruction. The president signed the Water Infrastructure Improvements for the Nation Act or the "WIIN Act," on December 16, 2016, which added the HHPD grant program under FEMA's National Dam Safety Program.

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/fire-management-assistance-grant-program).

If the **USACE** determines that a flood-control project falls within the **Continuing Authorities Program** (CAP), it will 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% USACE and 35% 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 website (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% 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 website (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 website (http://www.nab.usace.army.mil/whatwedo/civwks/pas.htm).

The **United States 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% 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 website (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 PA DCED website (http://www.newpa.com/find-and-apply-for-funding/funding-and-program-finder/municipal-assistance-program).

The **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% of the total cost of an approved application. More information is available through the PA DCED website (http://www.newpa.com/find-and-apply-for-funding/funding-and-program-finder/municipal-assistance-program).

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 programs are available to help communities meet the goals of the greenway initiative. More information is available through PA DCNR's greenways website (http://www.dcnr.state.pa.us/brc/conservation/greenways/index.htm).

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% 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 PA DCNR website (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 earthmoving. The grant addresses these and similar concerns through local, watershed-based planning, restoration, and protection efforts. More information is available through the PA DEP website (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% 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 website for more information on this program (http://www.depweb.state.pa.us/portal/server.pt/community/watershed_management/10593).

PA DEP offers low-interest loans through **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 stormwater 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% 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 website: http://www.portal.state.pa.us/portal/server.pt/community/pennvest/9242.

6.5 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 6-8, over 90 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 6-9 has been developed to identify the multi-jurisdictional approach to implementing the identified hazard mitigation measures. To assist in local implementation, Tables 6-8 and 6-9 have been combined to create a municipal-specific hazard mitigation action plan for each jurisdiction in the County. These municipal-specific hazard mitigation action plans are included in Appendix K. From the overall county perspective, these individual hazard mitigation action plans are to be implemented by the local emergency management coordinator working under the authority of and in concert with the local elected officials, as appropriate.

As part of the updated Hazard Mitigation Plan, Table 6-9 illustrates the status of the specific mitigation measures based on the responses received from all 72 municipalities. An “X” was placed in each cell which represents the specific mitigation measure as it pertains to each municipality or government entity. Upon review of the municipal responses, red color coding was used to indicate that the mitigation measure was completed, and no further action is required. Green color coding indicates the mitigation measure has been completed, but the mitigation measure should continue to be implemented. Yellow color coding indicates the mitigation measure has not been completed. Magenta color coding indicates that a new measure was identified, and brown shading indicates the mitigation measure is no longer applicable. *If shading was not indicated in a specific cell, the interpretation rendered no response as illustrated in Table 6-9 rather than indicating the mitigation measure was not completed.*

Based on the responses received from all 72 municipalities, it appears that the most commonly completed mitigation measures were the PMs followed by the ES measures. The majority of property protection and structural project mitigation measures were not completed. Development of this municipality-specific/multi-jurisdictional hazard mitigation strategy fulfills FEMA's requirements for multi-jurisdictional plan implementation.

7.0 PLAN MAINTENANCE

7.1 UPDATE PROCESS SUMMARY

This plan update is based on the most current data and information available to the County at the time it was prepared. This section identifies the parties responsible for monitoring, evaluating, and updating the plan in the future.

7.2 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 Berks County DES and coordinated with the representative members of the Mitigation Steering Committee on an annual basis via a Progress Monitoring Report (included in the appendices) to be submitted by December 31 of each year. Berks County DES 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 6-8 and 6-9 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 five-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 Berks County DES 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 Berks County DES 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.

7.2.1 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 new or amend their existing Comprehensive Plans 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 Plans, 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, SLD 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 5) 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.

7.3 CONTINUED PUBLIC INVOLVEMENT

Berks County is committed to involving the public in the continual reshaping and updating of this Hazard Mitigation Plan. Berks County DES is responsible for monitoring the plan and for the five-year review/update of the plan. In this capacity, it will also be the responsibility of Berks County DES (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 website. This site will also contain an e-mail address and telephone number to which people can direct their comments or concerns.

8.0 PLAN ADOPTION

In order for a multi-jurisdictional Hazard Mitigation Plan to be implemented, each jurisdiction (municipality) that is included in the plan must have its governing body adopt the plan, even when a regional agency (Berks County DES) prepares such a plan on behalf of the respective jurisdictions. As such, the original 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 and summarized in Table 3-2. Information regarding the adoption of the plan update is also included.