Frederick County Hazard Mitigation Plan

2016

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CHAPTER 1- INTRODUCTION

Introduction and Purpose

The *Frederick County Hazard Mitigation Plan* has been developed for Frederick County and its municipalities. Frederick County has 12 municipalities: Brunswick, Burkittsville, Emmitsburg, Frederick, Middletown, Mount Airy, Myersville, New Market, Rosemont, Thurmont, Walkersville, and Woodsboro (Figure 1.1). The purpose of this plan is to assess the communities' vulnerabilities to natural hazards and prepare a long-term strategy to address these hazards and prevent future damage and loss of life. The plan relies on active participation from county and municipality officials or residents in these communities. This is the second update of this plan. The original plan was developed in 2004 and approved in 2005, with the first update occurring in 2009.

Figure 1.1 Frederick County and its Municipalities

Location

Frederick County is bound by Pennsylvania to the north, Carroll County to the east, Montgomery County to the south, Howard County to the southeast, Washington County to the west, and Virginia to the southwest (Figure 1.2). The City of Frederick is the county seat.

Figure 1.2 Frederick County

County Profile

Background

Frederick County is Maryland's largest county in terms of geographic area. The City of Frederick, the county seat, is intersected by 5 interstate and national highways that provide easy access to Baltimore (46 miles), Washington, DC (43 miles), Gettysburg, PA (32 miles), Harpers Ferry, WV (21 miles), and Leesburg, VA (25 miles). The county is home to the 5,700-acre Catoctin National Park, site of the Camp David Presidential Retreat; Fort Detrick; Mount Saint Mary's University; Hood College; the Emergency Management Institute (EMI); and the National Fire Academy (NFA).

Population

Frederick County encompasses a total of 660.22 square miles and contains approximately 366.0 persons per square mile. Based on 2013 data from the U.S. Census Bureau, the estimated population in 2013 was 241,414, a 110.31 percent increase since 1980. Table 1.1 indicates recent and projected change in Frederick County population from 2010 to 2040.

Table 1.1 Population Change in Frederick County (Source: Frederick County Planning Department, 2014)

Year	Household	Population	Employment
2010	84,800	233,385	98,695
2015	89,935	241,616	102,014
2020	96,471	258,849	106,242
2025	103,944	278,654	109,802
2030	111,118	297,708	114,558
2035	117,365	314,297	116,332
2040	123,247	329,955	125,556

Table 1.2 shows the 2013 U.S. Census population estimates and the 2015 Frederick County Planning estimates for Frederick County municipalities.

Table 1.2 2013 Population Estimates (Source: U.S. Census Bureau 2013 and Frederick County Planning Department, October 2015)

Municipalities	2013 U.S. Census Population Estimates	2015 Frederick County Population Estimates
Brunswick	5,950	6,420
Burkittsville	166	151
Emmitsburg	2,980	2,814
Frederick City	65,840	68,504
Middletown	4,302	4,313
Mount Airy	9,289	3,785*
Myersville	1,942	1,655
New Market	763	1,083
Rosemont	350	294
Thurmont	6,272	6,194
Woodsboro	1,186	1,148
Walkersville	5,904	5,870
Unincorporated County	136,470	59,697 “Other Small Areas” 82,431
Total	**241,414**	**244,359**

*portion within Frederick County

Housing

According to the U.S. Census, the total number of housing units in the county in 2010 was 88,435 (approximately 94 percent of which were occupied). Of the total occupied housing units, approximately 77 percent were owner-occupied. The median value of owner-occupied housing units in 2010 was $349,500. Frederick County’s rapid growth is expected to continue until at least 2020. To keep pace with this growth, annual housing construction has also risen steadily over the past few decades.

Economy

Small business is the backbone of Frederick County’s economy. The County's businesses employ more than 91,000 workers, and an estimated 98 percent of these businesses have under 100 workers. Frederick County’s employers of 500 or more people include:

- Fort Detrick (including U.S. Army, National Cancer Institute and other tenants)
- Frederick County Board of Education
- Frederick Memorial Healthcare System
- Frederick County Government
- Ledios Biomedical Research
- Wells Fargo Home Mortgage
- Frederick Community College
- State Farm Insurance Co.
- Frederick City Government
- United Health Care
- Wal-Mart
- Astra Zeneca
- National Emergency Training Center (U.S. Fire Academy, FEMA, and other tenants)
- Lonza Bioscience Walkersville, Inc
- Mount Saint Mary's University

The county has experienced a significant increase in high-tech and bioscience companies, allowing more residents to work near where they live.[1] Frederick County is also Maryland's largest dairy producer, providing one-third of the state's milk production.

Transportation

The highway network in Frederick County can be broken into 3 categories:

- Freeway: includes Interstate 70, Interstate 270, U.S. Route 15 inside the City of Frederick, and U.S. Route 340;
- Four-lane Rural Highway: U.S. Route 15 north of the City of Frederick; and
- Two-lane Rural Highway: includes the state secondary highways (i.e., Maryland Route 75, Maryland Route 355, etc.), Maryland Route 15 south of the Maryland Route 340 split, as well as county roads.

The Frederick Municipal Airport, a city owned and operated facility, is an integral component of the county's overall transportation system. The Federal Aviation Administration (FAA) has designated the Frederick Municipal Airport as a "reliever airport," which is a general aviation facility designed to reduce congestion at airports that have substantial scheduled commercial passenger service (in this case, Dulles International, Ronald Reagan Washington National, and Baltimore Washington International Thurgood Marshall). The Frederick Municipal Airport is the state's second busiest general airport with over 140,000 annual operations. Over 260 aircraft are based there.[2]

Rail transportation includes CSX Transportation and Maryland Midland (short line service). In terms of mass transit, MARC (commuter rail) and Amtrak provide service to Washington, DC. The four MARC stations in Frederick County are Brunswick and Point of Rocks (on the Brunswick Line) and Monocacy and Frederick City (on the Frederick Line). Although there are no Amtrak stations in the county, Amtrak passes through the county on the line from Washington, DC, to Harpers Ferry, WV. Public bus transportation is available throughout the City of Frederick, connecting to other municipalities and multiple jurisdictions in the National Capital Region. The nearest major water port is the Port of Baltimore.

Utilities

Electricity is provided by the Allegheny Power System and Thurmont Municipal Light Company.

Natural gas is supplied by Frederick Gas Company, a division of Washington Gas. Baltimore Gas and Electric serves Mount Airy. Rocky Ridge and Emmitsburg are served by the South Penn Gas Company. Water and sewer services are provided by the Frederick County Division of Utilities and Solid Waste Management.

There are 27 public water service systems in the County; 7 of these systems are regional systems owned and operated by the county. There are also several small community systems and individual subdivision systems. Municipal water systems are located in Brunswick, Emmitsburg, Frederick, Middletown, Mount Airy, Myersville, Thurmont, Walkersville, and Woodsboro. The Potomac River provides approximately 80 percent of the County's public water supply, with the remaining 20 percent supplied by groundwater.[3] Two major institutional uses, Fort Detrick and Mount St. Mary's University, that maintain their own systems.

Municipal sewer systems are located in Brunswick, Emmitsburg, Frederick, Middletown, Mount Airy, Myersville, Woodsboro, and Thurmont. The county operates 16 plants serving a wide geographic area.

Why Plan for Mitigation?

In the past, federal legislation has provided funding for disaster relief, recovery, and some hazard mitigation planning. The Disaster Mitigation Act of 2000 (DMA2K), enacted in October 2000, improved this planning process. This legislation reinforced the importance of mitigation planning and emphasized planning for disasters before they occur. As such, DMA2K established the Pre-Disaster Mitigation (PDM) program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP). DMA2K was intended to facilitate cooperation between state and local authorities, prompting them to work together, and to encourage and reward local and state pre-disaster hazard mitigation planning. The goal of the planning process was to better enable local and state governments to articulate needs for mitigation, thus resulting in faster allocation of funding and more effective risk reduction projects.

The Frederick County Hazard Mitigation Plan is a multi-jurisdictional plan (i.e., a plan that includes municipalities and unincorporated areas of the county). Any future Federal Emergency Management Agency (FEMA) funding for mitigation projects is contingent upon plan approval and adoption. Any jurisdiction that does not participate in the planning process and adopt the plan will not be eligible for pre- and post-disaster FEMA Hazard Mitigation Assistance (HMA) program funds.

Purpose

Hazard mitigation is any action taken to permanently reduce or eliminate long-term risks to people and their property from the effects of natural hazards. Natural hazards come in many forms: tornadoes, floods, hurricanes, severe storms, winter freezes, droughts, landslides, and dam failures. Communities can take steps to prepare and implement mitigation techniques for almost any type of hazard that may threaten its citizens, businesses, and institutions.

This hazard mitigation plan establishes an ongoing hazard mitigation planning program by identifying and assessing potential natural hazards that may pose a threat to life and property, evaluating local mitigation measures that should be undertaken, and outlining procedures for monitoring the implementation of mitigation strategies. This plan also provides guidance to county officials and encourages activities that are most effective and appropriate for mitigating the effects of all identified natural hazards.

Consistency with State and Federal Mitigation Policies

The goals, objectives, and policies of the plan intend to implement the national and state directives for mitigation of natural hazards through local strategies.

Mitigation planning begins locally; however, the benefits accrue to the American people as a whole. According to FEMA, "mitigation efforts provide value to the American people by (1) creating safer communities by reducing loss of life and property, (2) enabling individuals to recover more rapidly from floods and other disasters, and (3) lessening the financial impact on the Treasury, states, tribes, and communities."[4]

The State of Maryland's Hazard Mitigation Goal is:

> *To protect life, property, and the environment from hazard events through:*
>
> - *Increased public awareness of hazard events, mitigation and preparedness.*
> - *Enhance coordination with jurisdictions to develop a relationship at the state and local level.*
> - *Efficient use of State resources.*

The state mitigation plan has seven objectives that support the mitigation goal:

1. Provide state guidance and technical assistance to enhance mitigation planning and project efforts by public and private stakeholders.
2. Enable MEMA to encourage each Maryland county or municipality to secure funding and initiate critical facility mitigation by obtaining HMA subgrants.
3. Support Unified HMA grant programs that acquire and demolish hazard prone structures or elevate, retrofit and relocate existing structures and facilities (including non-residential structures) in vulnerable locations with a priority on repetitive loss and severe repetitive loss structures.
4. Develop a comprehensive mitigation and preparedness program to educate private and public stakeholders, academia, government employees and elected officials on the hazards pertinent to the State.
5. Identify both state and local statutory, regulatory or policy-based initiatives that support Maryland mitigation planning actions and leverage support for their inclusion in upcoming updates (i.e. building code regulations).
6. Promote, identify and undertake three infrastructure mitigation projects to improve the state's resiliency to potential hazards.
7. Integrate the mitigation planning process, including the hazard vulnerability assessment, into related local and state plans (i.e. environmental plans, land use plans, comprehensive plans, mitigation plans).

Where possible, the goals, objectives, and strategies selected by Frederick County should align with the state plan's goals and objectives.

Planning Process

In compliance with DMA2K requirements, public participation was encouraged throughout the Frederick County mitigation planning process. Frederick County formed a Hazard Mitigation Planning Committee (HMPC), composed of various county agencies and representatives from each of the participating communities.

The HMPC was actively involved first in identifying hazards in the communities, reviewing the County's vulnerabilities to natural hazards, and making recommendations to reduce and prevent potential damage from these hazards. The committee then worked together to select the most appropriate and feasible mitigation measures.

The planning process involved four steps:

Step 1 - Organize Resources

Even before the HMPC was formed, the county organized their resources to ensure they had adequate technical assistance and expertise to form a hazard mitigation committee. Once formed, the HMPC included representatives from key county agencies such as planning, emergency management, GIS, and public works, as well as representatives from each of the incorporated municipalities.

Committee Membership

Representatives of the local municipalities and the county were invited to serve on the HMPC, which was tasked with conducting a DMA2K-compliant hazard mitigation planning process and preparing the hazard mitigation plan. Table 1.3 identifies the members of the committee and the agencies they represent.

Table 1.3 Frederick County Hazard Mitigation Planning Committee

Name	Agency or Municipality	Position/Role	HMP Kickoff (6/30/2015)	Natural Hazards HVA Meeting (9/15/2015)	Draft Plan Review (12/22/2015)	Participated in Review of Draft Plan and Provided Content for Plan
Jim Gugel	Frederick County Department of Comprehensive Planning	Planning Director, Division of Planning & Permitting	X			X
Seamus Mooney	Frederick County Department of Emergency Preparedness	Director of Emergency Preparedness, Project Manager	X	X	X	X
Ann Brown	Frederick County Department of Emergency Preparedness	Grants Manager		X		
Lynda Warthen	Frederick County Interagency Information Technology Division	GIS Project Manager	X	X		X
John E. (Jack) Markey	Frederick County Division of Emergency Management	Director		X		

Name	Agency or Municipality	Position/Role	HMP Kickoff (6/30/2015)	Natural Hazards HVA Meeting (9/15/2015)	Draft Plan Review (12/22/2015)	Participated in Review of Draft Plan and Provided Content for Plan
Jeremy Wade	Frederick County Division of Fire and Rescue Services	Active Battalion Chief	X	X	X	
Robert Shen	Frederick County Division of Public Works	Department Head, Department of Engineering and Construction Management/ Office of Project Management	X	X	X	
David Ennis	Frederick County Division of Public Works	Department Head, Office of Facility Maintenance		X	X	X
Barbara Rosvold	Frederick County Health Department	Public Health Emergency Planner				X
Sherman Coleman	Frederick County Office of Economic Development	Business Development Specialist, Minority Business Outreach		X		
Bruce DeGrange	Frederick County Police Department	Professional Services Division Manager		X		
Stephanie Sparks	Frederick County Police Department			X		
Bob McGrory	City of Brunswick	City Administrator		X	X	X
Richard Albee	City of Frederick Department of Engineering	Project Manager – H&H		X		
Tracy Coleman	City of Frederick Department of Engineering	Deputy Director of Public Works - Engineering		X		X
Joe Adkins	City of Frederick Planning Department	Deputy Director of Planning		X		X
Steven Horn	City of Frederick Planning Department	Director, Planning and Permitting Division			X	
Larry Smith	City of Frederick Planning Department	Zoning Administrator			X	
Barry Titler	St. Mary's University Public Safety	Director		X	X	X

Name	Agency or Municipality	Position/Role	HMP Kickoff (6/30/2015)	Natural Hazards HVA Meeting (9/15/2015)	Draft Plan Review (12/22/2015)	Participated in Review of Draft Plan and Provided Content for Plan
Debby Burgoyne	Mayor	Burkittsville				X
Jerry Muir	Town of Emmitsburg	Zoning Technician		X		X
Jim Click	Town of Emmitsburg	Deputy Director, Public Works		X		
Andrew Bowen	Town of Middletown	Town Administrator		X		X
Monika Weierbach	Town of Mount Airy	Zoning Administrator		X		X
Kristin Aleshire	Town of Myersville	Town Manager				X
Pat Faux	Town of New Market	Planner				X
Tom Watson	Town of Rosemont	Burgess				X
Jim Humerick	Town of Thurmont	Chief Administration Officer		X	X	X
Susan J. Hauver	Town of Walkersville	Town Planner & Zoning Administrator				X
Mary Rice	Town of Woodsboro	Town Manager				X

In addition to the meetings described above, Seamus Mooney held one-on-one meetings with each town to help them gather the information needed for the plans.

Data Collection

The mitigation plan update began with data collection. A kick-off meeting was held on June 30, 2015, with the Frederick County Director of Emergency Preparedness and representatives from the County's Public Works, Planning, Emergency Management, and Fire Departments. The planning process and proposed deliverables were discussed in detail.

Community, county, state, and federal resources were identified and contacted to collect pertinent policy and regulatory information from each of the communities and the County. This information included comprehensive plans, zoning ordinances, development ordinances, and building codes. The HMPC provided information about critical facilities, assets, and natural hazards including past occurrences, as well as projected frequencies of future occurrence and the anticipated risk, where available.

Step 2 - Assess Risks

The next step in the planning process was to perform a hazard identification and vulnerability assessment for the entire County. This process involved analyzing the County's greatest hazard threats and determining its most significant vulnerabilities with respect to natural hazards. Risk was determined by looking at the County's total threat and vulnerability for each hazard identified. The Hazard Vulnerability Assessment (HVA) was performed in large part using GIS data from the County, Hazus-MH MR 5 (a GIS-based FEMA loss estimation software), and state sources. At the

June 30, 2015, meeting, the HMPC reviewed the draft, including a brief history and profile of each hazard and areas vulnerable to various hazards.

The hazards initially identified in the 2009 plan were discussed and re-prioritized at the June kick-off meeting. The HVA was updated using the new prioritization. In addition, questionnaires were provided to committee members to garner HMPC comment about past hazard events.

Step 3 - Develop a Mitigation Plan

The third step was to assess the mitigation capabilities of the County and its municipalities. A capability assessment was performed to review the existing programs and policies addressing natural hazards. A thorough analysis of the adequacy of existing measures was performed, and potential changes and improvements were identified. The committee reviewed the capability assessment at the second HMPC meeting conducted on September 15, 2015. At this meeting, the committee worked to identify goals and objectives for countywide mitigation efforts. These goals represent the County's and communities' vision for disaster resistance.

Next, the committee worked to identify and develop potential mitigation actions for implementation. The HMPC considered issues related to potential damage from hazard events in the county. The committee also evaluated 2009 projects and helped draft an action plan to specify recommended projects, who is responsible for implementing the projects, and when they are to be completed.

It should be noted that the plan recommends mitigation measures that should be pursued and implemented if funding becomes available. Implementation of these recommendations depends on adoption of the plan by the County Executive and each of the municipalities, and the cooperation and support of the offices and contacts designated as being responsible for each action item.

Step 4 - Implement the Plan and Monitor Progress

The County will continue to implement the plan and perform periodic reviews and revisions through ongoing HMPC reviews and revisions. The Department of Emergency Preparedness will conduct an annual planning review of the mitigation plan, and public meetings will be held during the 5-year review/update period. Chapter 6 outlines plan implementation and maintenance.

Public Involvement

The public involvement element of the planning process involved 3 public meetings. The first public meeting was held on November 10, 2015, at the C. Burr Artz Trust Conference Room at the C. Burr Artz Library. A second meeting was held on December 10, 2015, and a third and final meeting on December 17, 2015; both of these meetings were also held at the library. Newspaper notices announcing meetings were published in the Frederick News-Post Classified section on December 6, 2015, December 8, 2015, December 13, 2015, and December 15, 2015 (Appendix D). Information from the draft HVA was available for review by the public and a public survey was made available both in hard copy at the meeting and on-line; contact information was available on-line if people wanted to submit comments. In addition, a copy of the draft plan was available for review at the third meeting. The on-line survey was also promoted via social media. Representatives from Frederick County Office of Emergency Preparedness were available to address questions and solicit input regarding the type of mitigation measures the HMPC should pursue.

MEMA serves as the state review agency for this mitigation plan. In addition to those included on the planning committee, the following agencies received a draft of the plan for review and comment:

- FEMA Region III

- Maryland Department of Natural Resources
- Maryland Department of the Environment (MDE)
- American Red Cross – Frederick County Chapter

Presentations were also made to the Frederick Chapter of the Maryland Municipal League (which includes representatives from the towns) and the Frederick County Planning Commission.

Existing Studies and Plans Reviewed

Planning documents, studies, guides, regulations/ordinances, and policies were reviewed and incorporated during the initial plan and each subsequent update. The plans included FEMA documents and emergency services documents, as well as county and local general plans, community plans, local codes and ordinances, and other similar documents. A full list of reports and plan used as data sources is included in the References section. They include:

- Frederick County and municipal comprehensive plans
- County and municipal codes and ordinances, including floodplain ordinances
- State and local mitigation planning guidance
- FEMA CRS-DMA2K Mitigation Planning Requirements
- 2009 MEMA and FEMA Crosswalk Comments
- FEMA RiskMAP Monocacy Watershed Discovery Report, September 2014

Organization of the Report

The next chapters comprise the Hazard Mitigation Plan. Chapter 2 identifies and profiles the hazards that could impact Frederick County. Chapter 3 presents the Vulnerability Analysis/Loss Estimation. Chapter 4 includes the goals and objectives for the plan. Chapter 5 discusses the mitigation projects that support achievement of the goals and objectives. Chapter 6 contains the plan for maintenance including monitoring and evaluation of plan implementation.

CHAPTER 2 – HAZARD IDENTIFICATION

Introduction

Risk assessment involves four major steps. This chapter discusses the first two steps—hazard identification and hazard profiling; Chapter 3 discusses the second two steps—vulnerability assessment and loss estimation.

Hazard identification for Frederick County involved investigating various types of natural hazards faced by the County, generally since 1900. Information on past hazards was based on research from historical documents and newspapers, county plans and reports, conversations with county residents and public officials, and websites. Data and maps were gathered online from sources such as the U.S. Geological Survey (USGS) and the National Climatic Data Center's (NCDC) National Storm Events Database (part of the National Weather Service), as well as from the Frederick County GIS Department, Public Health Department, and Division of Public Works.

Hazard profiling involves determining the frequency or probability of future events, their severity, and factors that may affect their severity. Each hazard type has unique characteristics that determine impact; for example, no two flood events will impact a community in the same manner. The unique characteristics of the community (geography, development, population distribution, age of buildings, etc.) also influence the potential impact of the hazard. Developing hazard event profiles enables us to anticipate the potential extent of the impact of each hazard.

Summary of Changes

The 2015 plan update consolidates, updates, and streamlines content from the 2004 and 2009 hazard identifications. Hazard priorities were expanded from a three-point ranking to a five-point scale based on Hazard Mitigation Planning Committee (HMPC) discussion during the kick-off meeting. This expansion aligns with the 2011 Maryland State Hazard Mitigation Plan scale relating relative risk to low, medium-low, medium, medium-high, and high.

The foundation of the 2009 hazard identification remained valid; each hazard was re-evaluated and a new analysis performed. The new analysis included: 1) revising the hazard profile and 2) adding historical occurrences based on new events or significant events not included in the previous plan. New maps and imagery were included. The 2011 Maryland State Hazard Mitigation Plan was reviewed as part of this update and, when applicable, information from the plan has been cited as such.

Hazard Identification

The natural hazards listed in Table 2.1 have been documented in Frederick County and assessed as risks for the purpose of the 2015 update; they have been categorized as follows: atmospheric, wildfire, hydrologic, and geologic. Hazards covered in this plan are shown in Table 2.1 classified by general hazard type.

Table 2.1 Hazard Identification

Hazard Type	New in 2015
Atmospheric Hazards	
Extreme Heat	Updated hazard history
Extreme Wind	Updated hazard history
Thunderstorm	Previously included as part of extreme wind; updated hazard history
Hailstorm	Previously included as part of thunderstorm; updated hazard history
Lightning	Updated hazard history
Severe Winter Weather	Updated hazard history
Tornado	Updated hazard history
Tropical Storm/Hurricane	Updated hazard history
Hydrological Hazards	
Drought	Updated hazard history
Flash Floods and Flooding	Updated hazard history; updated critical facility analysis
Dam and Levee Failure	Previously included in the manmade hazard annex; updated hazard history; updated critical facility analysis
Wildfire Hazards	
Wildfire/Wildland Urban Interface	Updated hazard history; updated critical facility analysis
Geological Hazards	
Earthquake	Updated hazard history; updated critical facility analysis
Landslide	Updated hazard history; updated critical facility analysis
Karst/Land Subsidence	Updated hazard history; updated critical facility analysis

Federal Disaster Declarations

Two important sources for identifying hazards that can affect a locality are the record of federal disaster declarations and historic storm data. According to FEMA, since 1962, there have been 25 major disaster declarations for Maryland, of which 13 have been declared for Frederick County. Nine of the declarations were for flooding/severe storm and four were for winter weather. In addition, there have been five emergency declarations in Maryland; Frederick County was included in all five declarations. Table 2.2 presents the declared disasters and available FEMA recovery programs since 1962.

Table 2.2 Presidential Declared Disasters for Frederick County, MD[5]

Disaster Number	Incident Type	Incident Date	Programs Declared			
			IH	IA	PA	HM
DR-309	Flooding, Severe Storm	8/17/1971		✓	✓	✓
DR-341	Flooding, Heavy Rains (Tropical Storm Agnes)	6/23/1972		✓	✓	✓
DR-489	Flooding, Heavy Rains	10/4/1975		✓	✓	✓
DR-522	Severe Storms, Flooding	10/14/1976		✓	✓	✓
DR-601	Severe Storms, Tornadoes & Flooding	9/14/1979		✓	✓	✓
EM-3100	Severe Snowfall & Winter Storm	3/13/1993			✓	✓
DR-1016	Severe Winter Weather & Ice Storm	2/8/1994			✓	✓
DR-1081	Severe Snow Storm (Blizzard of '96)	1/6/1996			✓	✓
DR-1094	Severe Storms, Flooding	1/19/1996		✓	✓	✓
DR-1139	Severe Storms, Flooding (Tropical Storm Fran)	9/6/1996		✓		✓

Disaster Number	Incident Type	Incident Date	Programs Declared			
			IH	IA	PA	HM
DR-1324	Severe Winter Storm	1/25/2000			✓	✓
EM-3179	Severe Snow Storm	2/14/2003			✓	✓
DR-1492	Flooding, Severe Storms, Wind (Hurricane Isabel)	9/18/2003	✓	✓	✓	✓
EM-3251	Sheltering, Evacuation (Hurricane Katrina)	8/29/2005			✓	
DR-1910	Severe winter storms and snowstorms	2/5/2010			✓	✓
EM-3335	Hurricane (Irene)	8/26/2011			✓	
EM-3349	Hurricane (Sandy)	10/26/2012			✓	
DR-4091	Hurricane (Sandy)	10/26/2012	✓		✓	✓
IH=Individual Housing IA=Individual Assistance		PA=Public Assistance HM=Hazard Mitigation				

Additional notable events that have occurred in or near Frederick County, MD, provided by the Frederick County Department of Emergency Preparedness, include:

- In April 2002, a prolonged drought strained water resources along the east coast, the effects of which were felt especially in Frederick, MD.[6]
- A tornado outbreak occurred on Friday, September 17, 2004 as Tropical Depression Ivan advanced northward up the spine of the Appalachians. Three tornados touched down in Frederick County.
- Between June 27 to 29, 2006, heavy rains caused significant flooding across much of the Mid-Atlantic region. In Frederick County, three people were killed when they attempted to cross the flood waters from Middle Creek and two teenagers drowned while swimming in a swollen creek that feeds into the Monocacy River.
- On December 19, 2009, the first of three major snowstorms of the season crippled much of the Mid-Atlantic region, dumping nearly two feet of snowfall across much of Frederick County. A second major snowstorm, which occurred February 5-6, 2010, is commonly referred to as “Snowmageddon.” On February 10, 2010, the third major snowstorm of the season dumped about two feet of snowfall across much of Frederick County.
- On June 29, 2012, a destructive complex of thunderstorms (derecho) moved through the Washington, DC metro area with winds of 60-80 mph, resulting in extensive damage and leaving more than 1 million area residents without power.
- On September 29, 2015, a heavy rainstorm dropped over 5 inches of rain in Frederick County and resulted in flash flooding in downtown City of Frederick and parts of the county. In total, 42 residents and 13 businesses reported damage from flooding. Radar estimated rainfall of 3 to 4 inches total in the city of Frederick, with 2 to 2.5 inches falling in one hour. Based on that 1 hour rainfall estimate, the event would be between a 10 and 25 year rainfall event for the area (4 to 10 percent chance of occurrence in any given year). The County has requested, via the State, a federal disaster declaration for the event.

NCDC Storm Events Data

NCDC storm events data is published by the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce. The storm events database contains information on storms and weather phenomena that have caused loss of life, injuries, significant property damage, and/or disruption to commerce from 1950 to May 2015. Records for the majority of weather events

were reported starting in 1993, with the exception of tornado, thunderstorm, and hail. There have been a total of 821 events for the hazards profiled in this report. Total property damages from these events exceed $44 million (adjusted for inflation). Table 2.3 summarizes the county totals by hazard. The hazard-specific sections in this report profile the historic events and include, when applicable, narratives from this dataset.

Table 2.3 NCDC Storm Events for Frederick County, MD[7]

Hazard Type	Period of Record	Total Events	Property Damage (2015$)	Crop Damage (2015$)	Injuries	Deaths
Atmospheric Hazards						
Extreme Heat	1993 - 2015	34	$0	$0	6	1
Thunderstorm	1950 - 2015	341	$3,805,851	$103,067	12	1
Extreme Wind	1993 - 2015	48	$704,023	$130,589	2	1
Hailstorms	1950 - 2015	64	$5,495	$19,235	0	0
Lightning	1993 - 2015	23	$1,164,012	$0	5	1
Severe Winter Weather	1993 - 2015	149	$365,170	$21,774	0	1
Tornado	1950 - 2015	35	$5,110,661	$75,400	1	0
Tropical Storm/Hurricane	1993 - 2015	2*	$5,259	$0	0	0
Hydrological Hazards						
Drought	1993 - 2015	12	$0	$36,139,3258**	0	0
Flash Floods and Flooding	1993 - 2015	136	$32,878,245	$60,320	1	8
Dam Failure	*Data not collected by NCDC. Analysis source to be used: USACE National Inventory of Dams and Levees.*					
Wildfire Hazards						
Wildfire/Wildland Urban Interface	*Data not collected by NCDC. Analysis source to be used: AMS fire database.*					
Geological Hazards						
Earthquake	*Data not collected by NCDC. Analysis source to be used: USGS Earthquake Hazards Program data.*					
Landslide	*Data not collected by NCDC. Analysis source to be used: USGS Landslide susceptibility data.*					
Karst/Land Subsidence	*Data not collected by NCDC. Analysis source to be used: USGS Engineering Aspects of Karst data and County historical data.*					
	Total	**821**	**$44,038,715**	**$36,549,711**	**22**	**12**

*Five tropical storm/hurricane events were categorized as floods or not recorded in the NCDC database.
** Zonal damages for 3 regional droughts spanning 1997 - 1999

It should be noted that these estimates are believed to be an underrepresentation of the actual losses experienced because losses from events that go unreported or that are difficult to quantify are not likely to appear in the NCDC database; this is especially true with crop damages. As shown in Table 2.3, several of the hazards are not collected in the NCDC storm events database. Each of the individual hazard sections uses the best available national and local data. In most cases, Frederick County departments have provided supplemental data for past events and damages.

Atmospheric Hazards

Extreme Heat

Overview and Profile

Temperatures that hover ten degrees or more above the average high temperature for the region sustained over several weeks are defined as extreme heat. A heat wave is primarily a public health concern. During extended periods of very high temperatures or high temperatures with high humidity, individuals can suffer a variety of ailments, including heat stroke, heat exhaustion, heat syncope, and heat cramps. Individuals with existing medical conditions such as heart disease or respiratory problems are at higher risk, as extreme heat can exacerbate such conditions.

- Heat stroke, in particular, is a life threatening condition that requires immediate medical attention. It occurs when the body's core temperature rises above 105°F as a result of environmental temperatures. Patients may be delirious, stuporous, or comatose. The death-to-cure ratio in reported cases in the United States averages about 15 percent.
- Heat exhaustion is much less severe than heat stroke. The body temperature may be normal or slightly elevated. A person suffering from heat exhaustion may complain of dizziness, weakness, or fatigue. The primary cause of heat exhaustion is fluid and electrolyte imbalance. The normalization of fluids will typically alleviate the situation.
- Heat syncope is typically associated with exercise by people who are not acclimated to exercise. The symptom is a sudden loss of consciousness. Consciousness returns promptly when the person lies down. The cause is primarily associated with circulatory instability as a result of heat. The condition typically causes little or no harm to the individual.
- Heat cramps are typically a problem for individuals who exercise outdoors, but are unaccustomed to heat. Similar to heat exhaustion, heat cramps are thought to result from a mild imbalance of fluids and electrolytes.

In 1979, R.G. Steadman, a meteorologist, developed the heat index (or apparent temperature), which is shown in Figure 2.1 and Table 2.4, to illustrate the risk associated with extreme summer heat.

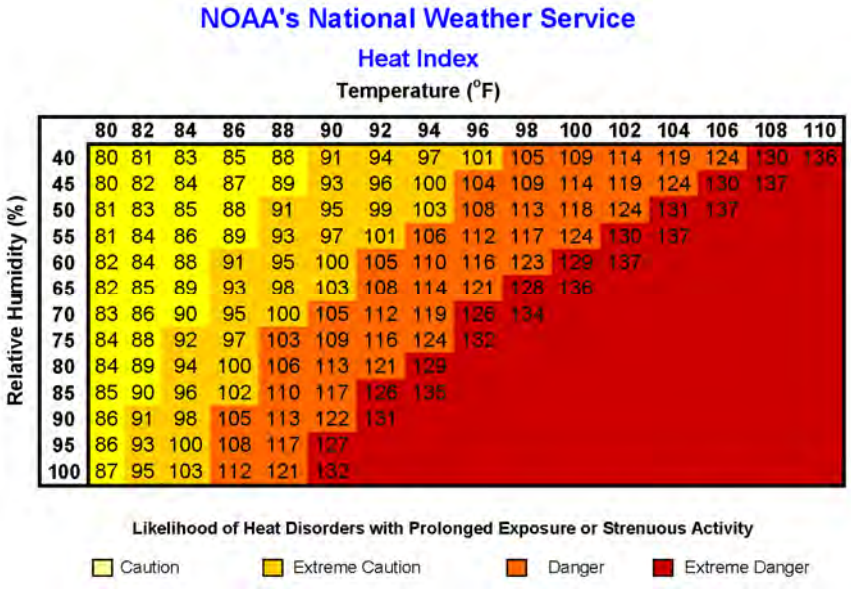


Figure 2.1 National Weather Service (NWS) Heat Index Chart

Table 2.4 Heat Danger Categories

Danger Category	Heat Disorders	Heat Index (°F)
IV Extreme Danger	Heatstroke or sunstroke imminent.	>130
III Danger	Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and physical activity.	105-130
II Extreme Caution	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and physical activities.	90-105
I Caution	Fatigue possible with prolonged exposure and physical activity.	80-90

In addition to posing a public health hazard, periods of excessive heat usually result in high electrical consumption for air conditioning, which can cause power outages and brownouts. Children and individuals with chronic existing medical conditions are especially susceptible to heat stroke. Large urban areas such as the City of Frederick can create an island of heat that can raise the temperature by 3 to 5 degrees Farenheit. Therefore, urban communities with susceptible residents could face a significant medical emergency during an extended period of excessive heat.

Hazard History

Based on data from the National Climatic Data Center (NCDC), there have been 34 incidents of extreme heat between 1993 and 2015. Frederick County typically experiences one to two extreme heat events each year. Some of the more recent occurrences are described below. Events before 2010 are included in Appendix A.

- On July 22, 2011, strong upper-level high pressure built over the region. Surface high pressure over the Atlantic Ocean caused moist air to move into the region from the south. Strong subsidence underneath the upper-level high caused extremely hot conditions with air temperatures over 100 degrees. The combination of the heat and high humidity caused

heat indices to soar to as high as 120 degrees. Numerous reports of heat-related illnesses were received by State health authorities.

- On June 29, 2012, a large amount of moisture from the Gulf of Mexico moved into the area. The high humidity, upper-level high pressure, and abundant sunshine caused extremely hot conditions with heat indices topping 105 degrees.
- On July 18 and 19, 2013, high pressure was located over much of the eastern United States for two consecutive days and light southerly flow persisted all week, which led to above normal temperatures and dew points in the mid-70s. Heat indices were around 105 to 106 degrees in the region.

Thunderstorm

Overview and Profile

A thunderstorm is a convective rain or snow shower accompanied by lightning and thunder.[8] As the warm air rises, thunderhead clouds (cumulonimbus) form causing the strong winds, lightning, thunder, hail, and rain associated with these storms. Instability can be caused by surface heating or upper tropospheric (~50,000 feet) divergence of air (rising air parcels can also result from airflows over mountainous areas). Generally, surface-heating "air mass" thunderstorms form on warm season afternoons and are not severe. Upper tropospheric "dynamically-driven" thunderstorms generally form in association with a cold front or other regional-scale atmospheric disturbance. These storms can become severe, producing strong winds, frequent lightning, hail, downbursts, and occasionally tornadoes.

The National Weather Service defines a thunderstorm as a local storm accompanied by lightning and thunder, produced by a cumulonimbus cloud, usually with gusty winds, heavy rain, and often hail. Non-severe thunderstorms rarely have duration exceeding two hours. The National Weather Service considers a thunderstorm severe if it produces one inch diameter hail, has winds exceeding 58 miles per hour, and/or produces a tornado. Significant severe thunderstorms are distinguished by stronger winds (75 mph or greater), hail two inches in diameter, and/or an EF2 or greater tornado. These severe storms have the potential to initiate flash flooding. Thunderstorms may occur singly, in clusters, or in lines. Some of the most severe weather occurs when a single thunderstorm stalls over one location for an extended time.

Other hazards associated with thunderstorms include downbursts, or strong downdrafts. Downdrafts induce outbursts of straight-line winds on or near the ground. They may last anywhere from a few minutes during small-scale microbursts to periods of up to 20 minutes in larger, longer macro-bursts. Wind speeds in downbursts can reach 150 mph and can result in damages similar to tornado damages (discussed below).

Thunderstorms affect relatively small areas when compared with hurricanes and winter storms. The typical thunderstorm is 15 miles (24 kilometers) in diameter and lasts an average of 25 minutes. Of the estimated 100,000 thunderstorms occurring each year in the United States, only 10 percent are classified as severe. Downbursts and straight-line winds associated with thunderstorms can produce winds of 100 to 150 miles (161 to 241 kilometers) per hour—enough to flip cars, vans, and pickup trucks. The resulting damage can equal the damage of most tornadoes.[9]

NWS Storm Prediction Center (SPC) issues Day 1, Day 2, and Day 3 Convective Outlooks that depict non-severe thunderstorm areas and severe thunderstorm threats across the contiguous United States. The categorical forecast specifies the level of the overall severe weather threat via numbers (e.g., 5), descriptive labeling (e.g., HIGH), and colors (e.g., magenta). The probabilistic forecast directly expresses the best estimate of a severe weather event occurring within 25 miles

of a given point. The text narrative begins with a listing of severe thunderstorm risk areas by state and/or geographic region. This is followed by a concise, plain-language summary of the type(s) of threat along with timing that is focused on the highest-risk areas. The NWS uses the following categories to classify risk from thunderstorms (see Figure 2.2):

- **TSTM** (light green) - General or non-severe thunderstorms - Delineates, to the right of a line, where a 10 percent or greater probability of thunderstorms is forecast during the valid period.
- **1-MRGL** (dark green) - Marginal risk - An area of severe storms of either limited organization and longevity or very low coverage and marginal intensity.
- **2-SLGT** (yellow) - Slight risk - An area of organized severe storms, not widespread in coverage with varying levels of intensity.
- **3-ENH** (orange) - Enhanced risk - An area of greater (relative to Slight risk) severe storm coverage with varying levels of intensity.
- **4-MDT** (red) - Moderate risk - An area where widespread severe weather with several tornadoes and/or numerous severe thunderstorms is likely, some of which should be intense. This risk is usually reserved for days with several supercells producing intense tornadoes and/or very large hail, or an intense squall line with widespread damaging winds.
- **5-HIGH** (magenta) - High risk - An area where a severe weather outbreak is expected from either numerous intense and long-tracked tornadoes or a long-lived derecho-producing thunderstorm complex that produces hurricane-force wind gusts and widespread damage. This risk is reserved for when high confidence exists in widespread coverage of severe weather with embedded instances of extreme severe weather (i.e., violent tornadoes or very damaging convective wind events).

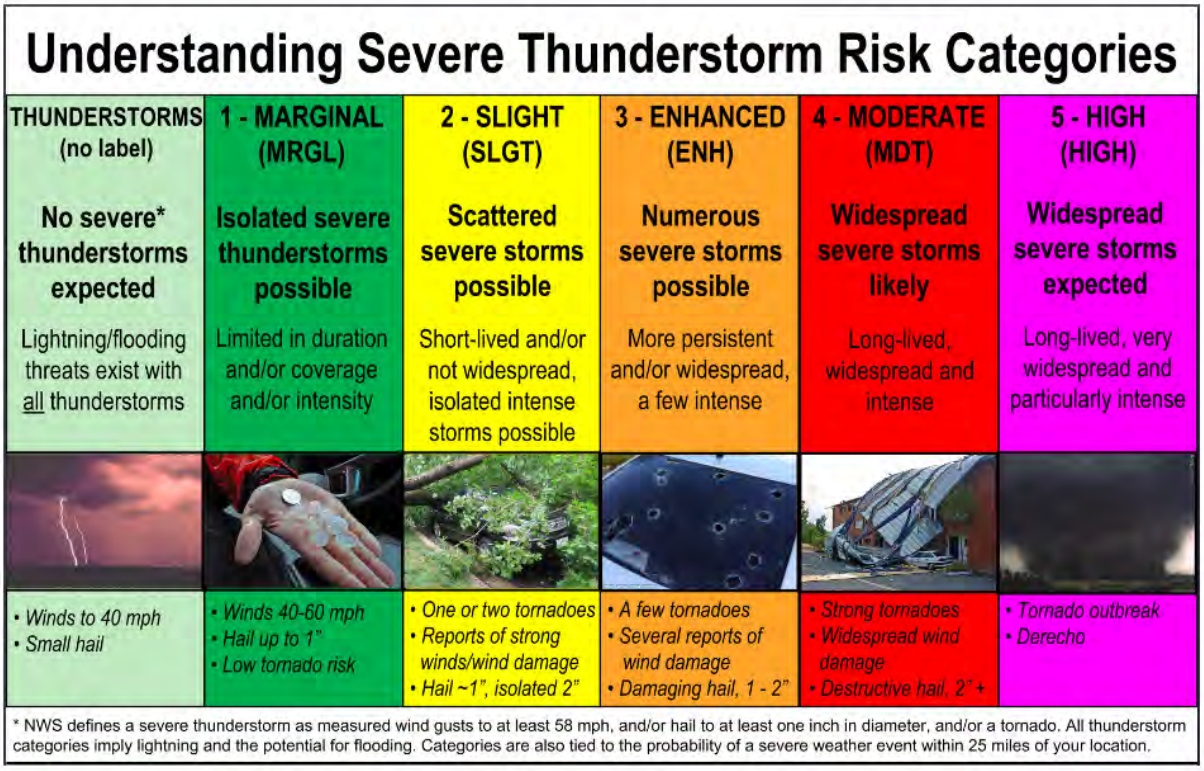


Figure 2.2 NWS Severe Weather Risks

Hazard History

As shown in Table 2.2, there have been 6 federal disaster declarations related to severe storms in Frederick County. There have been 341 reports of thunderstorms since 1950, when the National Weather Service began keeping track of these occurrences. Damages recorded for these events include $3.8 million dollars of property damages and $103,067 in crop damages; not all damages are captured in the National Weather Service data so this is likely a lower dollar figure than actual damages.

Some notable occurrences (e.g., damages greater than $10,000) are described below:

- On August 3, 2012, damaging winds caused several trees to be knocked down. Damaging winds also caused a barn roof to come off. Damages estimated at $15,000.
- On June 29, 2012, a strong upper-level disturbance triggered a line of thunderstorms that caused widespread tree damage and brought down transformers throughout the county. Storm damages totaled $50,000.
- The roof of a large dairy barn was destroyed on June 22, 2012 by a thunderstorm downburst with estimated winds of around 80 mph. Many trees in the area were uprooted or destroyed by this thunderstorm, and property damages totaled about $25,000.
- Strong thunderstorms moved through the county on August 12, 2010, bringing structural damage to a drag racing facility near Green Valley.

Extreme Wind Events

Overview and Profile

Extreme wind events occur when there is a large difference in atmospheric pressure over a short distance, called a pressure gradient. The larger the pressure gradient over a certain area, the stronger the winds will generally be. Strong cold fronts and low pressure systems separating two distinctly different air masses lead to strong winds. Typically, non-thunderstorm strong wind events occur most often in autumn, winter, and spring when the temperature difference between air masses is the greatest.

The National Weather Service issues the following wind alerts:

- **Wind Advisory**—when sustained non-thunderstorm winds range from 25 mph to 39 mph and/or gusts to 57 mph.
- **High Wind Watch**—when there is the potential for non-thunderstorm high wind speeds to develop and pose a hazard, or otherwise be life-threatening.
- **High Wind Warning**—when non-thunderstorm high wind speeds are occurring and may pose a hazard or are life-threatening. For a High Wind Warning to be issued, non-thunderstorm winds either must be sustained at 40 mph or greater for one hour or longer, or 58 mph or greater than 58 mph for any duration.

Table 2.5 provides guidance used by the NWS when estimating wind speed from damages.

Table 2.5 Estimating Wind Speed from Damage (Source: National Weather Service)

Wind Speed	Observations
26-38 knots (30-44 mph)	Trees in motion. Light-weight loose objects (i.e. lawn furniture) tossed or toppled.
39-49 knots (45-57 mph)	Large trees bend; twigs, small limbs break, and a few larger dead or weak branches may break. Old/weak structures (e.g. sheds, barns) may sustain minor damage. Buildings partially under construction may be damaged. A few loose shingles removed from houses. Carports may be uplifted; minor cosmetic damage to mobile homes.
50-64 knots (58-74 mph)	Large limbs break; shallow rooted trees pushed over. Semi-trucks overturned. More significant damage to old/weak structures. Shingles, awnings removed from houses; damage to chimneys and antennas; mobile homes, carports incur minor structural damage; large billboard signs may be toppled.
65-77 knots (75-89 mph)	Widespread damage to trees with trees broken/uprooted. Mobile homes may incur more significant structural damage, be pushed off foundations, or overturned. Roofs may be partially peeled off industrial/commercial/warehouse buildings. Some minor roof damage to homes. Weak structures (i.e. farm buildings, airplane hangars) may be severely damaged.
78+ knots (90+ mph)	Many large trees broken and uprooted. Mobile homes severely damaged; moderate roof damage to homes. Roofs partially peeled off homes and buildings. Moving automobiles pushed off dry roads. Barns, sheds demolished.

Extreme wind events pose a danger to Frederick County because they can result in localized or widespread power outages, property damage, and falling trees. Injury or death to people can result from falling objects or flying debris. Extreme wind events can also blow over tractor trailers on the highway and make driving difficult in a high-profile vehicle or lightweight vehicle. They can turn trash cans, lawn and patio furniture, and other property into projectiles resulting in further property damage.

Most deaths in extreme wind events are caused by trees falling onto cars or homes. Dead trees or trees weakened by drought, disease, rotting, or pest infestations are the most susceptible to falling.

Hazard History

There have been 48 reports of extreme wind events since 1993 , when the National Weather Service began keeping track of these occurrences. These events have resulted in $704,023 dollars of property damages and $130,589 in crop damages. Frederick County typically experiences between two and three extreme wind events each year. Some of these occurrences are described below:

- Gusts of 66 mph were measured on March 12, 2014, in Thurmont downing multiple trees. This wind resulted from a cold front moving through the Mid Atlantic that caused widespread gusts of 55 mph with localized higher windspeeds in the region.
- On February 26, 2010, a wind gust of 63 mph was measured near Ballenger Creek. Dozens of trees were down along U.S. Route 15 between Thurmont and Frederick. This damage resulted from a low pressure system that moved into the northeast on February 25, 2010,

rapidly intensifying into the 26th. The strong pressure gradient that developed caused very gusty winds and damages totaling $6,000.

- On January 25, 2010, a low pressure system tracked through the Ohio Valley and into the Great Lakes, causing strong gusty winds to develop ahead of a cold front, bringing down numerous trees across the County. Property damages approached $4,000.
- On June 29, 2012, a destructive complex of thunderstorms (derecho) moved through the Washington, DC metro areas with winds of 60-80 mph, resulting in extensive damage and leaving more than 1 million area residents without power.

Hailstorms

Overview and Profile

Hailstorms are violent and spectacular phenomena of atmospheric convection, always associated with heavy rain, gusty winds, thunderstorms, and lightning. Hail is a product of strong convection and occurs only in connection with a thunderstorm where the high velocity updrafts carry large raindrops into the upper atmosphere (where the temperature is well below the freezing point of water).

Hailstones grow in size when the frozen droplet is repeatedly blown into the higher elevations. The hailstone ascends as long as the updraft velocity is high enough to hold the hailstone. As soon as the size and weight of the hailstone overcome the lifting capacity of updraft, it begins to fall freely under the influence of gravity. Falling hailstones, under thunderstorm conditions, are accompanied by a cold downdraft of air.

Most damaging hailstones range from the size of a golf ball ("severe") to the size of a softball or larger ("oversized"). According to the National Weather Service, most parts of the United States experience "severe" and "oversized" hailstorms. The largest recorded hailstone in the United States fell in Coffeyville, Kansas, on September 3, 1970, and measured more than 7.0 inches in diameter and weighed 1.7 pounds, generating an impact force of 578 pounds per foot. Hailstorms occur year round at all times of day, but are more frequent in the summer months, in the evenings, and after sunset.

Large hail, and the glass it may break, can injure people and animals. Hail can be smaller than a pea, or as large as a softball, and can be very destructive to automobiles, glass surfaces (e.g., skylights and windows), roofs, plants, and crops. The size of hailstones is a direct function of the severity and size of the storm. Hailstorms occur more frequently in the late spring and early summer and are more common in the Midwest. The land area affected by individual hailstorms is not much smaller than that of a parent thunderstorm, an average of 15 miles in diameter around the center of a storm.

Hazard History

A total of 64 hailstorms were reported in Frederick County between 1950 and 2015. These events have resulted in $5,495 dollars of property damages and $19,235 in crop damages in recorded losses. Not all damages are captured in the National Weather Service data so this is likely a lower dollar figure than actual damages. Frederick County averages about one hail event each year. Some recent reports of hail are described below. Events before 2010 are included in Appendix A.

- A strong upper-level disturbance passed through the region on June 29, 2012. Extremely hot and humid conditions caused high amounts of instability and triggered strong thunderstorms with golf ball sized hail and widespread wind damage.

- On April 25, 2010, golf ball size hail was reported in Burkittsville. The combination of a strong cold front and instability caused showers and thunderstorms to develop across the region. Due to plenty of cold air aloft, thunderstorms produced large hail.

Lightning

Overview and Profile

Lightning is defined as a sudden and violent discharge of electricity from within a thunderstorm due to a difference in electrical charges. It represents a flow of electrical current from cloud-to-cloud or cloud-to-ground. Nationally, lightning causes extensive damage to buildings and structures, kills or injures people and livestock, starts untold numbers of forest fires and wildfires, and disrupts electromagnetic transmissions. Lightning is extremely dangerous during dry lightning storms because people may remain outside due to the lack of precipitation.

At any given time, there are nearly 2,000 thunderstorms in progress over the earth's surface simultaneously. At least 100,000 thunderstorms occur annually throughout the United States. To the public, lightning is often perceived as a minor hazard; however, lightning-caused damage, injuries, and deaths make lightning a significant hazard associated with any thunderstorm in any area of Maryland. Damage from lightning occurs in four ways: (1) electrocution/severe shock to humans and animals; (2) vaporization of materials along the path of the lightning strike; (3) fire caused by high temperatures associated with lightning (10,000-60,000°F); and (4) sudden power surge that can damage electrical/electronic equipment. Large outdoor gatherings (e.g., sporting events, concerts, campgrounds) are particularly vulnerable to lightning strikes that can result in injuries and deaths.

Hazard History

There were 23 major lightning events in Frederick County between 1993 and 2015. NCDC storm data only documents events in which a fatality, injury, or damage resulted from lightning. These events have resulted in $1.1 million dollars of recorded property damages. Not all damages are captured in the National Weather Service data so this is likely a lower dollar figure than actual damages. No significant lightning events have taken place since the 2009 plan update. See Appendix A for events prior to 2010.

Severe Winter Storms

Overview and Profile

Winter storms can vary in size and strength and include heavy snowstorms, blizzards, freezing rain, sleet, ice storms, and blowing and drifting snow conditions. Extremely cold temperatures accompanied by strong winds can result in wind chills that cause bodily injury, such as frostbite and death. A variety of weather phenomena and conditions can occur during winter storms. For clarification, the following are National Weather Service-approved descriptions of winter storm elements:

- **Heavy snowfall** - the accumulation of six or more inches of snow in a 12 hour period or eight or more inches in a 24 hour period.
- **Blizzard** - the occurrence of sustained windspeeds over 35 mph accompanied by heavy snowfall or large amounts of blowing or drifting snow for more than three hours.
- **Freezing drizzle/freezing rain** - precipitation that falls as liquid, but freezes on contact with roads, trees, power lines and other surface structures that are below 32 degrees F, forming a dangerous glaze of ice.

- **Ice storm** - a type of winter storm characterized by freezing rain which results in a dangerous coating of ice on trees, power lines, and road surfaces.
- **Sleet** - solid grains or pellets of ice formed by the freezing of raindrops or the refreezing of largely melted snowflakes. Sleet does not cling to surfaces.
- **Wind chill** – a calculated temperature index that describes the combined effect of wind and low air temperatures on exposed skin.

Maryland's worst winter storms are nor'easters, which usually occur when an arctic air mass is in place. While high pressure builds over New England, cold arctic air flows south from the high-pressure area. The dense cold air is unable to move west over the Appalachian Mountains, so it funnels south down valleys and along the Coastal Plain. Winds around a nor'easter's center can become intense. The strong northeast winds that rack the coast and inland areas give the storm its name. The wind builds large waves that batter the coastline and sometimes pile water inland, causing major coastal flooding and severe beach erosion. Unlike hurricanes, which usually pass within one tide cycle, a nor'easter can linger through several tides, each one piling more and more water on shore and into the bays, dragging more sand away from the beaches.

The entire county is vulnerable to the effects of winter storms. These storms may include snowstorms, sleet storms, ice storms, and blizzards. Major winter storms and occasional blizzard conditions bring bursts of heavy snow accumulating 3 to 6 inches in short periods or 1 to 2 feet in 12 to 24 hours. Blizzard conditions develop with winds over 35 mph. Freezing rain and drizzle create a coating of ice that is hazardous to walk or drive on. Other impacts include hazardous conditions caused by falling trees and power lines; requirement of additional manpower to clear debris, remove snow, and salt roads; large-scale use of public shelters; and traffic delays.

Hazard History

As shown in Table 2.2, there have been four federal disaster declarations related to severe snowfall and winter storms in Frederick County. There were a total of 149 winter related events in Frederick County between 1993 and 2015. According to the NCDC, there were 51 major winter storms, 1 major blizzard, 7 heavy snow events, and 7 ice storms. The remaining 83 events were classified as general winter weather events. These events have resulted in $365,170 of property damages and $21,774 in crop damages. Total costs associated with the maintenance (snow removal) and repair of roads and utilities, provided by Frederick County Division of Public Works (DPW), Department of Highway and Facility Maintenance, were $11.7 million from 2010 through 2015. On average, the county spends $1.95 million a year on snow related response.

Frederick County typically experiences 6 to 7 severe winter events each year. Two such events since 2009 are described below. Events before 2010 are included in Appendix A.

- On February 4 to 5, 2014, a low pressure system brought ice accumulations of a quarter inch to Point of Rocks.
- Three major winter storms hit the County during the winter of 2009/2010. The first major storm occurred on December 19, 2009, the second on February 5 and 6, 2010, and the third on February 10, 2010. All three storms dumped upwards of two feet of snow on parts of the County. The February 5 and 6 storm brought snowfall totals of 29.5 inches 2 miles northeast of Jefferson, and 29.0 inches near Frederick. Much of remainder of the winter was spent recovering from the blizzards. Expenditures from the 2009/2010 winter season, as provided by DPW, totaled $2.1 million.

Tornadoes

Overview and Profile

A tornado is a relatively short lived storm composed of an intense rotating column of air, extending from a thunderstorm cloud system. Average winds in a tornado, although never accurately measured, are thought to range between 100 and 200 miles per hour, but some may have winds exceeding 300 miles per hour. The following are National Weather Service definitions of a tornado and associated terms:

- Tornado - A violently rotating column of air that is touching the ground.
- Funnel cloud - A rapidly rotating column of air that does not touch the ground.

Tornadoes are classified on a scale of 0 to 5 by the degree of damage they cause. This tornado classification, shown in Table 2.6, is called the Enhanced Fujita Scale.

Table 2.6 Tornado Damage Scale (Source: NOAA Storm Prediction Center)

Enhanced Fujita Scale	Wind Speeds (mph)	Scale	Wind Speeds (mph)	Damage	Frequency
EF0	65-85	F0	40 to 72	Some damage to chimneys, TV antennas, roof shingles, trees, and windows	29%
EF1	86-110	F1	73 to 112	Automobiles overturned, carports destroyed, trees uprooted	40%
EF2	111-135	F2	113 to 157	Roofs blown off homes, sheds and outbuildings demolished, mobile homes overturned	24%
EF3	136-165	F3	158 to 206	Exterior walls and roofs blown off homes. Metal buildings collapsed or severely damaged. Forests and farmland flattened.	6%
EF4	166-200	F4	207 to 260	Few walls, if any, standing in well-built homes. Large steel and concrete missiles thrown far distances.	2%
EF5	Over 200	F5	261 to 318	Homes leveled with all debris removed. Schools, motels, and other larger structures have considerable damage with exterior walls and roofs gone. Top stories demolished.	Less than 1%

Nearly 70 percent of deaths from tornadoes happen to people in residential structures. Of these, over 40 percent are located in mobile homes, which are easily overturned and destroyed due to the low wind resistance of the structures.

A tornado path averages four miles, but may reach up to 300 miles in length. Typical widths range from 300 to 400 yards, but severe tornadoes have cut swaths a mile or more in width, or have formed groups of two or three funnels traveling together. Typically, tornadoes move between 25 and 45 miles per hour, but land speeds of up to 70 miles per hour have been reported. Tornadoes rarely last more than a couple of minutes over a spot for more than 15 to 20 minutes in a ten-mile area, but their short duration does not limit their devastation of an area. The destructive power of

a tornado results primarily from its high wind velocities and sudden changes in pressure. Damages from tornadoes result from extreme wind pressure and windborne debris. Since tornadoes are generally associated with severe storm systems, they are often accompanied by hail, torrential rain, and intense lightning. Depending on their intensity, tornadoes can uproot trees, bring down power lines, and destroy buildings. Flying debris is the main cause of serious injury and death.

Downbursts are characterized by straight-line winds. Downburst damage is often highly localized and resembles that of tornadoes. There are significant interactions between tornadoes and downbursts; a tornado's path can be directed by downbursts. The path of a tornado can be very unpredictable, including veering right and left or even a U-turn.

FEMA's publication *Design and Construction Guidance for Community Shelters* July 2000, presents a map of four wind zones in the United States (consistent with American Society of Civil Engineers Publication 7-98) and provides design wind speeds for shelters and other critical facilities. Zone IV shows the areas of highest wind activity, which are generally in the Midwest and "Tornado Alley," while Zone I shows the areas of lowest activity, which are in the western part of the United States. Frederick County falls in Zone III, with design wind speeds up to 200 milse per hour.

Hazard History

There has been one federal disaster declaration (September 14, 1979) related to tornadoes in Frederick County. Data from the NCDC show that Frederick County experienced 35 tornado events between 1950 and August 2015. These events have resulted in $5.1 million of property damages and $75,400 in crop damages.

Frederick County typically experiences about one to two tornadoes each year. Four events since 2010 are described below. Events before 2010 are included in Appendix A.

- On August 12, 2010, thunderstorms developed that produced damaging winds and large hail. Numerous trees were uprooted and large limbs were snapped. The damage to trees and debris showed a convergent and weakly rotational pattern which suggests there was a weak tornado near and just north of Westvale Court. Total costs associated with the repair of roads and utilities, provided by Frederick County Division of Public Works, Department of Highway and Facility Maintenance, show $13,831 in damages.
- On April 16, 2011, an EF1 tornado developed from a strong low pressure system causing a detached garage to collapse along New London Road. Shingles and siding were removed from a single-family home and softwood trees were snapped along New London Road. Numerous hardwood trees were uprooted or snapped and barns were damaged or destroyed. Roofing panels were removed from a detached garage near Detrick Road and Old Annapolis Road. Six or more softwood trees were snapped and pieces of large limbs and plywood were impaled in adjacent roofs. In addition, substantial tree damage was noted near Talbot Run Road. Pine trees were snapped near Buffalo Road and there was also a report of siding and trim torn from a home near Buffalo Road. Property damages exceed $125,000.
- On May 17, 2011, an F0 tornado traveled more than a mile causing trees to snap and uproot along a track that began from south-southeast of the intersection of Forest School Road and Brandenburg Hollow Road to southwest of the intersection of Garfield Road and John Cline Road. Minor shingle damage was noted to two structures. Siding was partially removed from a single-family home, where a backyard play center that had been bolted to the ground was snapped from its moorings and rolled.

- On June 20, 2015, an F0 tornado caused damage along a 1.5 mile path beginning near the intersection of Tuscarora Road and Buckeystown Pike, then moved northeast to Greenfield Road. Large tree branches were snapped half way up and trees were nearly pushed over from south to north near the intersection of Tuscarora Road and Buckeystown Pike. Additional tree damage occurred at two residences just north of the intersection. Another small tree was snapped over in a southeast to northwest direction about one half mile north of the residences. A large tree was snapped over at the base in a north to south direction at a residence just off Buckeystown Pike near Greenfield Road. On the backside of the residence and along Greenfield Road, an additional large tree branch was also snapped in a north to south direction.

Although a torndado's magnitude and location are unpredictable, most of those that occurred in the County during the last 50 years have been classified as low intensity (F1). There were three cases of F2 tornadoes and one F3 tornado event. Although these tornadoes caused no fatalities, they resulted in roadblocks, delays, and the nuisance and cost of clearing fallen trees and debris.

Tropical Storm/Hurricane

Overview and Profile

Hurricanes and tropical storms, as well as tropical depressions, are tropical cyclones defined by the National Weather Service's National Hurricane Center as warm-core non-frontal synoptic-scale cyclones, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation around a well defined center. Once formed, tropical cyclones maintain themselves by extracting heat energy from the ocean at high temperatures and releasing heat at the low temperatures of the upper troposphere. Hurricanes and tropical storms bring heavy rainfall, storm surge, and high winds, all of which can cause significant damage. These storms can last for several days and, thus, have the potential to cause sustained flooding, high wind, and erosion. In coastal areas, storm surge also can cause significant damage.

Tropical storms and hurricanes are classified using the Saffir-Simpson Hurricane Scale (Table 2.7), which rates the intensity of hurricanes based on wind speed and barometric pressure measurements. The scale is used by the National Weather Service to predict potential property damage and flooding levels from imminent storms.

Table 2.7 Saffir-Simpson Scale and Typical Damages

Category	Sustained Wind Speeds (mph)	Surge (ft)	Pressure (mb)	Typical Damage
Tropical Depression	<39	--	--	
Tropical Storm	39-73	--	--	
Hurricane 1	74-95	4-5	> 980	*Minimal* – Damage primarily to shrubbery and trees, unanchored manufactured homes damaged, some signs damaged, no real damage to structures on permanent foundations.
Hurricane 2	96-110	6-8	965-980	*Moderate* – Some trees toppled, some roof coverings damaged, major damage to manufactured homes.
Hurricane 3	111-130	9-12	945-965	*Extensive Damage* – Large trees toppled, some structural damage to roofs, manufactured homes destroyed, structural damage to small homes and utility buildings.
Hurricane 4	131-155	13-18	920-945	*Extreme Damage* – Extensive damage to roofs, windows, and doors; roof systems on small buildings completely fail; some curtain walls fail.
Hurricane 5	> 155	> 18	< 920	*Catastrophic Damage* – Roof damage considerable and widespread, window and door damage severe, extensive glass failures, some buildings fail completely.

Hazard History

According to the NCDC, NOAA, and referencing the list of presidentially-declared disasters, seven tropical storm events have occurred in Frederick County since 1972: Agnes, Fran, Ivan, Isabel, Hanna, Irene, and Sandy. Ivan and Hanna were the only ones that did not cause enough damage to result in a disaster declaration. The impacts of storms since 2010 are described below.

- On September 29, 2012, Hurricane Sandy made landfall in coastal New Jersey, and resulted in significant damage across a large area of the Northeast and Mid-Atlantic coasts. According to the Frederick County Division of Public Works, Department of Highway and Facility Maintenance, the storm resulted in $360,802 in damages associated with the repair of roads and utilities in Frederick County.
- Between August 27 and 28, 2011, Hurricane Irene produced tropical storm conditions across portions of Maryland bringing high rainfall totals and widespread power outages from downed trees and power pines. At least 8 roads were closed due to downed trees. A maximum of 2,714 customers were out of power. According to the Frederick County Division of Public Works, Department of Highway and Facility Maintenance, the storm resulted in $26,720 in damages associated with the repair of roads and utilities.

Hydrologic Hazards

Drought

Overview and Profile

Drought is a condition of climatic dryness that is severe enough to reduce soil moisture and water and snow levels to below the minimum necessary for sustaining plant, animal, and economic systems. Drought is a complex physical and social process of widespread significance. It is not usually a statewide phenomenon; differing conditions in the state often make drought a regional issue. Despite all of the problems that droughts have caused, drought has proven to be difficult to define, and there is no universally accepted definition. Drought, unlike a flood, is not a distinct event. It is often the result of many complex factors and typically has no well-defined start or end. In addition, its impacts vary by affected sector.

The most commonly used drought definitions are based on meteorological, agricultural, hydrological, and socioeconomic effects:

- Meteorological drought is often defined by a period of substantially diminished precipitation duration and/or intensity. The commonly used definition of meteorological drought is an interval of time, generally on the order of months or years, during which the actual moisture supply at a given place consistently falls below the climatically appropriate moisture supply.
- Agricultural drought occurs when there is inadequate soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought usually occurs after or during meteorological drought, but before hydrological drought. It can also affect livestock and other dry-land agricultural operations.
- Hydrological drought refers to deficiencies in surface and subsurface water supplies. It is measured as streamflow, snowpack, lake, reservoir, and groundwater levels. There is usually a delay between lack of rain or snow and less measurable water in streams, lakes, and reservoirs. Therefore, hydrological measurements tend to lag behind other drought indicators.
- Socioeconomic drought occurs when physical water shortages start to affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product.

Droughts result from prolonged periods of dry weather accompanied by extreme heat and usually occur during the summer months (July and August). The warmest time of the year in Frederick County is July when maximum temperatures average 89 degrees. Extreme temperatures of 100 degrees occur occasionally. The occurrence of drought cannot be predicted.

When drought begins, agriculture is usually first to be affected because of heavy dependence on stored soil moisture. Soil moisture can be rapidly depleted during extended dry periods. Dryland farming and ranching are the most at risk from drought. Water uses that depend on in-stream flows are at high risk but less exposed; these include irrigated farms; aquatic, wetland, and riparian environmental communities; and recreational activities. Urban and agricultural water users who rely on reservoirs and wells that are not dependent on high rates of aquifer recharge are the last to experience drought.

Drought also has a major impact on livestock and crops. Approximately half of Frederick County is dedicated to agriculture, making up 10 percent of the state's farm area. Frederick County has the largest amount of farmland, 181,512 acres, and pastureland (29,219 acres) in the state. The main crops are forage land, soybeans, corn, and wheat.

There are 1,308 farms in Frederick County, a 10 percent decrease from 2007. The amount of livestock on these farms, according to the U.S. Department of Agriculture's 2012 Census, is shown in Table 2.8 and Table 2.9.

Table 2.8 Number and Types of Livestock Farms (Source: U.S. Department of Agriculture)

Livestock Type	Number of Farms Reporting	Inventory (animals)
Turkeys	Not Disclosed	Not Disclosed
Layers (Chickens)	211	50,075
Cattle and calves	600	45,498
Hogs and pigs	45	5,232
Horses and ponies	344	2,719

Table 2.9 Number and Types of Crop Farms (Source: U.S. Department of Agriculture)

Crop Type	Number of Farms Reporting	Inventory (acres)
Forage	692	36,810
Soybeans	227	30,021
Corn for grain	286	28,008
Corn for silage	121	13,251
Wheat	184	12,585

Hazard History

Data reveals that Frederick County experienced 12 drought periods from 1950 to 2015, often spanning several years. Over $36 million has been estimated for zonal (multiple county) damages for three regional droughts that occurred between 1997 and 1999. No significant droughts have been recorded since 2010; events prior to 2010 are summarized in Appendix A.

Flash Floods and Flooding

Overview and Profile

Flash floods, as the name suggests, occur suddenly after a brief but intense downpour. They move fast and terminate quickly. Although the duration of these events is usually brief, the damages can be quite severe. Flash floods also result as a secondary effect from other types of disasters, including dam breaks and denuded ground from large wildfires. Wildfires remove vegetative cover and alter soil characteristics, increasing the quantity and velocity of storm water runoff, and dam breaks release large quantities of water into receiving drainage ways in a very short timeframe. Flash floods are the primary weather-related killer, with approximately 140 deaths recorded in the United States annually.

Riverine floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies use historical records to determine the probability of occurrence for different extents of flooding. The probability of occurrence is expressed as the percentage chance that a flood of a specific extent will occur in any given year. On the other hand, flash floods cannot be predicted accurately and happen whenever there are heavy storms (Table 2.10).

Table 2.10 Causes of Flooding versus Flash Flooding

Causes of Flooding	External Issues that Exacerbate Flash Flooding
Low lying, relatively undisturbed topography	Hilly/mountainous areas
High water tables	High velocity flows
Soil characteristics	Short warning times
Constrictions in the floodway or floodplain (filling)	Steep slopes
Obstructions in the floodway or floodplain (bridges)	Narrow stream valleys
Excess paved surfaces	Parking lots and other impervious surfaces
Poor drainage	Improper drainage

In support of the National Flood Insurance Program (NFIP), FEMA identifies and maps areas of flood risk. One of these areas is the Special Flood Hazard Area (SFHA), which is defined as an area of land that will be inundated by a flood having a 1 percent chance of occurring in any given year. This flood is often referred to as the "base flood" or "100 year flood." However, the term "100 year flood" is misleading. It is not the flood that will occur once every 100 years; rather, it is the flood elevation that has a 1 percent chance of being equaled or exceeded each year. Thus, the 100 year flood could occur more than once in a relatively short period of time. The 100 year flood, which is the standard used by most federal and state agencies, is used by the NFIP as the standard for floodplain management and to determine the need for flood insurance. A structure located in an SFHA shown on an NFIP map has a 26 percent chance of suffering flood damage during the term of a 30 year mortgage. Smaller floods occur more often than larger and more widespread ones.

The Coordinated Needs Management Strategy (CNMS) is a nationwide program to identify and manage flood hazard mapping needs. The goal is to identify areas where existing flood maps are not based on data that can be validated against today's standards. In the CNMS, studied stream miles are classified as Valid, Unverified, or Unknown based on whether the underlying engineering methods meets validation criteria. Frederick County has 1 Unverified mile and 145 Valid miles of detailed study in the Monocacy Watershed. There are 57 Unverified miles and 167 Valid miles of approximate study in the Monocacy Watershed.[10] Generally, this means that Frederick County's flood maps are based on data in line with today's engineering standards.

Flood damage to residences can be devastating, both emotionally and financially. Flood damage to businesses could result in loss of income, wages, and tax revenues. Other effects include outbreaks of disease, widespread animal illnesses, disrupted utilities, water pollution, fire, and washed out roads and culverts.

Hazard History

There have been 6 federal disaster declarations related to flooding in Frederick County (not including those associated with tropical systems). These include September 1996, January 1996, September 1979, October 1976, October 1975, and August 1971.

According to the NCDC, 136 flood events were reported in Frederick County, Maryland, from 1993 to August 2015. Sixty of these events were classified as flash floods, 56 as general flooding, and 20 related to heavy rains and flooding. These events have resulted in $32.8 million of property damages and $60,320 in crop damages. Total costs associated with the repair of roads and utilities, provided by Frederick County Division of Public Works, Department of Highway and

Facility Maintenance, show $292,375 in damages from flooding on April 16, 2011, $23,059 from flooding on May 17, 2011, and $34,012 from flooding on June 20, 2015.

Frederick County typically experiences 5 to 6 flood events each year. Events prior to 2009 are summarized in Appendix A. The county has experienced several events since 2009:

- On September 29, 2015, an estimated rainfall of 3 to 5.5 inches caused flooding severe enough to meet the SBA disaster declaration threshold. There were reports of flash flooding; 42 residents and 13 businesses reported damage from flooding.
- Beginning on June 20, 2015, remnants of Tropical Storm Bill moved into the Mid-Atlantic causing moisture to increase. Showers and thunderstorms led to heavy rain across the Interstate 95 corridor and flash flooding occurred. Some rivers also swelled to flood stage on June 21, 2015. Numerous county roads (e.g., Rooks Court, Ijamsville Road, and Ballenger Creek Pike). The stream gauge on Collington Branch at Leeland Road reached flood stage at 12 feet. It crested at 14.68 feet on June 21, 2015 at 00:10 EST.
- On May 16, 2014, a deep upper level trough tapped into Gulf and Atlantic moisture which led to heavy rain across the Mid Atlantic. Tropical-like conditions resulted in showers and thunderstorms to persist before a cold front moved through later in the day. The intersection of Annandale and Hampton Valley Road was closed due to high water. There was flooding on U.S. Highway 40 at Marker Road. Flooding was reported at MD State Highway 85 near Manor Woods Road. The river gauge at Bridgeport reached flood stage.
- On April 30, 2014, a warm front moved northward and showers and thunderstorms broke out across the area. Heavy rain produced flash flooding and rapid rises on streams and creeks. Maryland Route 355 was flooded and closed at Bennett Creek. In addition, there were numerous road closures north of the City of Frederick due to high water.
- On January 30, 2013, an upper level trough moved eastward and across most of the eastern United States with a surface low pressure center across the eastern Great Lakes. A cold front moved through the Mid Atlantic with dew points in the low 60s ahead of frontal passage. Flooding and flash flooding also occurred along or just ahead of the frontal passage. There was a water rescue of a woman from atop her stranded car on a flooded portion of Peters Road. There were multiple road closures reported throughout the County including a bridge under water near the intersection of Marston Road and Sims Creek Road.
- On October 29, 2012, Crow Rock Road was flooded at Wolfsville Road after the remnants of Hurricane Sandy moved through the area.
- On October 2, 2012, there was a road closed near the intersection of Maryland Route 31 and Oak Orchard Road due to water across the roadway.
- On September 18, 2012, a cold front moved through the region and showers and severe thunderstorms occurred across the Mid Atlantic. A strong low level jet drove activity through the Interstate 95 corridor and abundant moisture produced heavy rain. There were numerous roads closed in Frederick County including Frederick and Thurmont. For example, 12 to 18 inches of water covered Patrick Street near West Frederick Middle School, and the intersection of Maryland Route 140 and Harney Road flooded.
- On September 23, 2011, a band of moderate to heavy rain set up across much of Maryland, and flooding and flash flooding occurred across portions of northern Maryland. Numerous roads in Frederick County, including Maryland Route 77 near Owens Creek and Maryland

Route 76 south of Mount Saint Mary's College were flooded; rain gauges recorded between 1.10 and 2 inches.

- On September 9, 2011, abnormally moist atmosphere across the mid-Atlantic allowed showers and thunderstorms to produce exceptional rainfall rates across portions of Maryland as the remnants of Tropical Depression Lee interacted with a nearly stationary boundary near the Mason-Dixon line. Major flooding and flash flooding occurred in numerous areas. Maryland Route 80 was flooded and closed west of Ed McClain Road.
- On August 14, 2011, as low pressure approached from the west, periods of heavy rain and thunderstorms moved across Maryland. Several roads were closed due to high water.
- On July 8, 2011, a nearly stationary low pressure trough existing in a moist and unstable atmosphere aided in the development of showers and thunderstorms across northern Maryland. Many major roadways throughout the city of Frederick were flooded.
- On April 28, 2011, a strong cold front slowly passed through the region in the morning. A southerly flow ahead of the front caused deep moisture over the area. The cold front combined with the instability triggered showers and thunderstorms with very heavy rainfall rates. Slow moving and training convection combined to produce flash flooding in some locations, as over 3.5 inches of rain fell in spots, resulting in numerous road closures.
- On April 16, 2011, a strong and closed low pressure system over the Ohio Valley remained nearly stationary, bringing copious moisture northward up the eastern seaboard. Lift to produce showers and thunderstorms was focused along a warm front that passed north through the mid-Atlantic during the morning. With ground already saturated from several rounds of significant rainfall in the previous week, flooding and flash flooding resulted. A high water rescue was performed from a submerged vehicle on U.S. Route 40 in the vicinity of Catoctin Creek. A rain gauge in the area recorded 1.85 inches. Numerous roads were closed in Thurmont and Emmitsburg due to flooding, among other locations throughout the County.
- On September 30, 2010, heavy bands of rain caused numerous road closures due to flash flooding. Rain gauges in the County measured 4.02 to 4.6 inches.
- On March 13, 2010, a slow-moving low pressure system moved up the Mid-Atlantic coast producing widespread heavy rainfall. The 2 to 4 inches of rain combined with nearly saturated antecedent conditions, producing flooding over northern Maryland resulting in the closure of numerous roads. A rain gauge near Greenfield Road off of Maryland Route 85 measured 3.33 inches.

Dam and Levee Failure

Overview and Profile

Dams are artificial barriers with the ability to impound water, wastewater, or liquid-borne materials. They serve to regulate water supply, control floods, provide hydroelectric power, or aid fishing and recreation. Dams are constructed across watercourses to retain and control runoff for water supply, flood control, and power generation. Most dams in Maryland consist of an earthen embankment to retain water and a combination of spillways designed to convey water safely around or through the facility. Dams are sources of concentrated vulnerability and can be serious disaster agents when they fail. There is often little to no advance warning prior to a dam failure. Hydrologic, geologic, seismic, and structural problems are leading potential causes of dam failure. [11]

FEMA defines dam failure as the "catastrophic type of failure characterized by the sudden, rapid, and uncontrolled release of impounded water." While minor types of dam failure can occur and can lead to catastrophic failure, in most cases minor dam issues can be corrected.

Dams can fail for several reasons:

- Overtopping caused by floods that exceed the capacity of the dam
- Deliberate acts of sabotage
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate maintenance and upkeep.[12]

Dams may present significant hazards to the communities where they are located. Dams are classified by the hazard they present in the event of failure. The national ranking system consists of 3 hazard levels:

1. High hazard level indicates a probable loss of life. Dam failure would result in major increases in existing flood levels at houses, buildings, major interstates, and state roads with more than 6 lives in jeopardy.
2. Significant hazard level indicates a possible loss of life. Dam failure would result in significant increase in flood risks to roads and buildings with no more than 2 houses or 6 lives in jeopardy.
3. Low hazard level indicates an unlikely loss of life. Dam failure would result in minor increases to existing flood levels at roads and buildings.[13]

The severity of a dam failure depends on its storage capacity and the types of land uses downstream. Hazard potential is the possible adverse consequences resulting from the release of water and other stored contents due to failure or improper operation of the dam. Once a dam is constructed, the downstream hydrologic regime may change, altering the frequency and severity of flood events. The change in hydrologic regime can encourage encroachment on a reduced 100-year floodplain that otherwise would not have been developed if the dam were not constructed; therefore, the flood control benefits provided by a dam can sometimes encourage downstream development and increase the dam's overall hazard potential.

Hazard History

As of August 2015, there have been no major dam failures in Frederick County. Some examples of dam failures in the United States are shown below in Table 2.11.

Table 2.11 Dam Failures in the United States

Dam Name	Location	Date	Description
Taum Sauk Reservoir	Lesterville, MO	December 14, 2005	Breach occurred suddenly, sending 1.3 billion gallons of water through Johnson's Shut-Ins State Park, destroying the park and injuring a family.[14]
Big Bay Dam	Purvis, MS	March 12, 2004	Embankment failed, releasing water up to 30' high. 104 structures were damaged or destroyed; no lives were lost.[15]
Lawn Lake Dam	Rocky Mountain National Park, CO	July 15, 1982	Dam failed, sending water up to 30' high down the Roaring River. 3 died, and damages were estimated at $31 million. The probable cause of failure was deterioration of caulking, leading to erosion and eventual failure.[16]
Coal Waste Dam	Buffalo Creek, WV	February 26, 1972	Tailings dam failed, killing 125, injuring 1,100, and destroying over 3,000 homes.
Teton Dam	Teton River, ID	June 5, 1976	Dam failure killed 11 and caused $1 billion in damage. Over 4,000 homes and over 4,000 farm buildings were destroyed.
Kelly Barnes Dam	Georgia	November, 1977	Dam failure killed 39, mostly college students.[17]
South Fork Dam	Johnstown, PA	May 31, 1889	A combination of heavy rains, design flaws, and substandard repairs resulted in a dam failure that caused the Johnstown Flood, resulting in 2,209 deaths.

Dams are rated according to their potential to cause damage in the event of failure. A hazard rating of “high” indicates that 6 or more persons are at risk if the dam fails; “significant” indicates that one to five persons are at risk; and “low” indicates that zero persons are at risk. Dams are also rated according to their condition, based on subjective field inspections: excellent, good, fair, poor, very poor, unsafe, or breached. Condition ratings can change and should be considered relative rather than absolute. There are 21 dams located in Frederick County, of which 4 are considered high risk, 1 significant, and 13 low risk. Three dams have not been assigned a hazard rating. The high risk dams are noted to be in excellent condition based on field inspections.

Wildfire Hazards

Wildfires and Urban-Wildland Interface Fires

Overview and Profile

A wildfire is an uncontrolled fire spreading through vegetative fuels, such as brush, marshes, grasslands, forests, or fields, exposing and possibly consuming structures. They often begin unnoticed and spread quickly, usually signified by dense area-wide smoke. Wildfires are sometimes called “forest fires”; however, this analysis will use “wildfire.” Some of the most common wildfire causes include lightning, human carelessness, and arson. A wildland-urban interface (WUI) fire is a wildfire in a geographic area where structures and other human development meet or intermingle with wildland or vegetative fuels. Fires can be rated based on their degree of combustion as noted in Table 2.12.

Table 2.12 Fire Danger Rating Descriptions

Rating	Description
Low	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or decayed wood. Fires in open cured grasslands may burn freely for a few hours after rain, but woodland fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spreading.
Moderate	Fires can start from most accidental causes, but with the exception of lightning, the number of starts is generally low. Fires in open cured grasslands will burn briskly and rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
High	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to become uncontrolled. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and difficult to control unless they are attacked successfully while small.
Very High	Fires start easily from all causes and spread rapidly and increase quickly in intensity immediately after ignition. Spot fires are a constant danger. Fires burning in light fuels may quickly develop intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.

Wildfires can occur at any time of day and during any month of the year, and the season length and peak months may vary appreciably from year to year. Land use, vegetation, amount of combustible materials present, and weather conditions such as wind, low humidity, and lack of precipitation are the chief factors determining the number of fires and acreage burned. Generally, fires are more likely when vegetation is dry from a winter with little precipitation and/or a spring and summer with sparse rainfall. Wildfires are capable of causing significant injury, death, and damage to property. The potential for property damage from fire increases each year as more recreational and full-time residential properties are developed on wooded land. Fires can extensively impact the economy of an affected area, especially the recreation and tourism industries, upon which Frederick County depends. Major direct costs associated with forest fires or wildfires are fire suppression, subsequent salvage and removal of downed timber and debris, and restoration of the burned area. If burned woodlands and grasslands are not replanted quickly to prevent widespread soil erosion, landslides, mudflows, and floods can follow, compounding the damage.

Hazard History

Frederick County Fire AMS data from 2010 through 2015 indicates there were 119 calls related to wildfires or vegetation fires. Ninety-four of the calls were confirmed to be vegetation fires and were responded to accordingly. From this data, on average, Frederick County responds to 19 vegetation-related fires each year.

Data from the Maryland State Hazard Mitigation plan includes Department of Natural Resources total wildfire events. As shown in Figure 2.3, the northwestern portion of the County has an elevated wildfire risk as compared to the central and eastern portions. Approximately 5.9 percent of the county is located within an extreme wildfire risk, and 21.7 percent within a high risk area. Between 1998 and 2010, Frederick County experienced 381 incidences, accounting for $18,882 in damages.

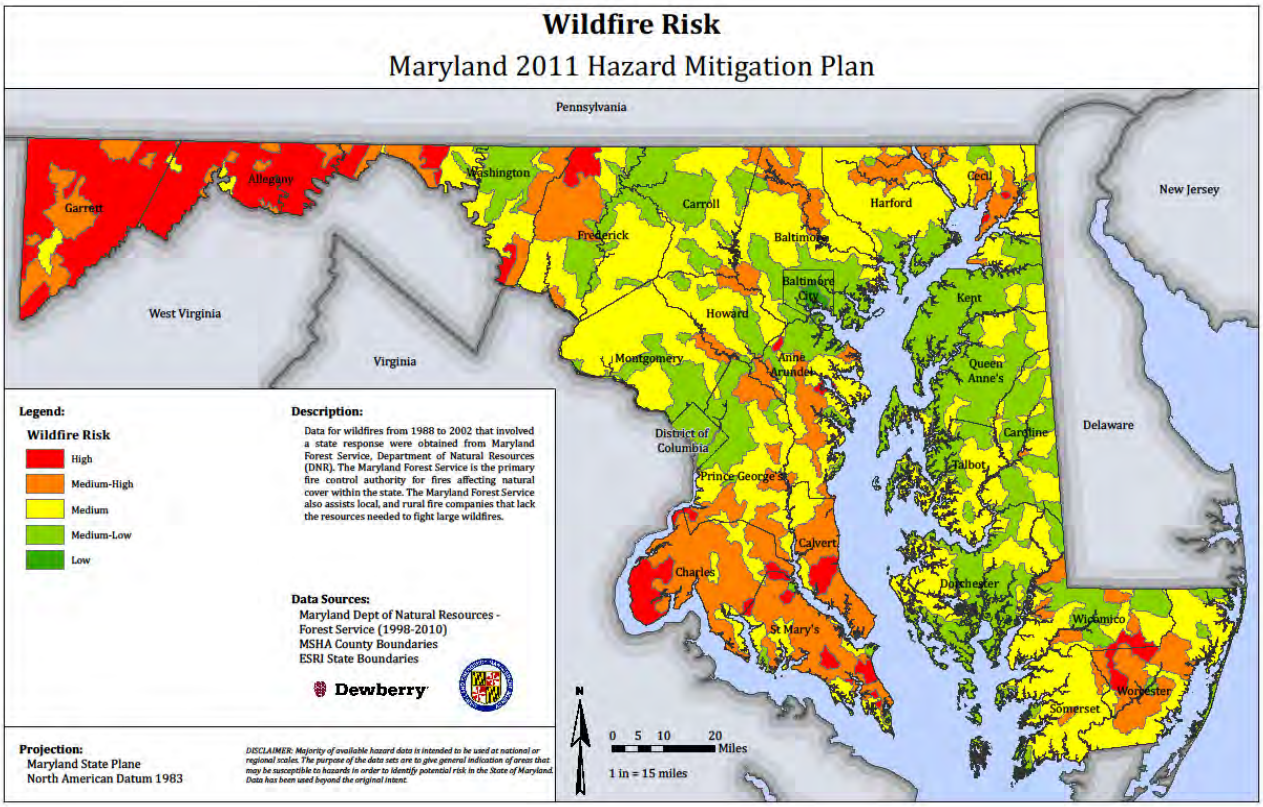


Figure 2.3 Fire Hazard Potential (Source: 2011 Maryland State Hazard Mitigation Plan)

Geologic Hazards

Earthquakes

Overview and Profile

An earthquake is a shaking or violent trembling of the earth that results from the sudden shifting of rock beneath the earth's crust. This sudden shifting releases energy in the form of seismic waves or wave-like movement of the earth's surface. Earthquakes can strike without warning and may range in intensity from slight tremors to great shocks.

Measurement of the severity of an earthquake can be expressed in several ways, the two most common being intensity (using human judgment) and magnitude (using seismographs). The Modified Mercalli Intensity (MMI) Scale is an intensity scale expressed in Roman numerals, which reports the amount of shaking and effects at a specific location based on expert judgment. The scale has twelve classes and ranges from I (not felt) to XII (total destruction). The lower intensities are described in terms of people's reactions and sensations, whereas the higher intensities relate to observable structural damage.

Magnitude is an objective measure of earthquake severity and is closely related to the amount of seismic energy released at the focus of an earthquake. It is based on the amplitude of seismic waves as recorded on standardized seismographs. The standard for magnitude measures is the Richter Scale, an open-ended scale expressed in whole numbers and decimal fractions. An earthquake measuring 6.0 on the Richter scale is ten times more powerful than a 5.0 and one hundred times more powerful than an earthquake measuring 4.0. This is a measure of the absolute size or strength of an earthquake and does not consider the effect at any specific location.

Another way of measuring the potential damage of an earthquake is the peak ground acceleration (PGA). The PGA is measured as a percentage and refers to the maximum percentage of acceleration of the movement of the ground. A higher PGA means a more rapid movement of the ground and a higher probability of structural damage.

Since the 2010 Frederick County Hazard Mitigation Plan, USGS has released updated national seismic hazard maps to account for new methods, models, and data. Figure 2.4 shows PGA for the United States. This represents the fastest measured change in speed for a particle at ground level that is moving horizontally due to an earthquake with a 2 percent probability of exceedance in 50 years.[18] Values are given in %g, where g is acceleration due to gravity, or 9.8 meters per second squared. All communities in Frederick County are located within the PGA rank of 4%g to 6%g (shown in light blue on the map). Table 2.13 correlates the MMI scale with magnitude and the PGA method.

Earthquakes can last from a few seconds to more than five minutes, and they may also occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris, because the tremors shake, damage, or demolish buildings and other structures. Disruption of communications, electrical power supplies, and gas, sewer, and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides, or releases of hazardous material, compounding their disastrous effects.

Table 2.13 Magnitude, Modified Mercalli Intensity Scale and Peak Ground Acceleration Comparison (Source: FEMA Publication 386-2, "Understanding Your Risks")

Magnitude	MMI	Acceleration (%g) PGA	Perceived Shaking	Potential Damage
1.0 – 3.0	I	<0.17	Not Felt	None
3.0 – 3.9	II-III	.17-1.4	Weak	None
4.0 – 4.4	IV	1.4-3.9	Light	None
4.5 – 4.9	V	3.9-9.2	Moderate	Very Light
5.0 – 5.4	VI	9.2-18	Strong	Light
5.5 – 5.9	VII	18-34	Very Strong	Moderate
6.0 – 6.4	VIII	34-65	Severe	Moderate to Heavy
6.5 – 6.9	IX	65-124	Violent	Heavy
7.0 or higher	X-XII	>124	Extreme	Very Heavy

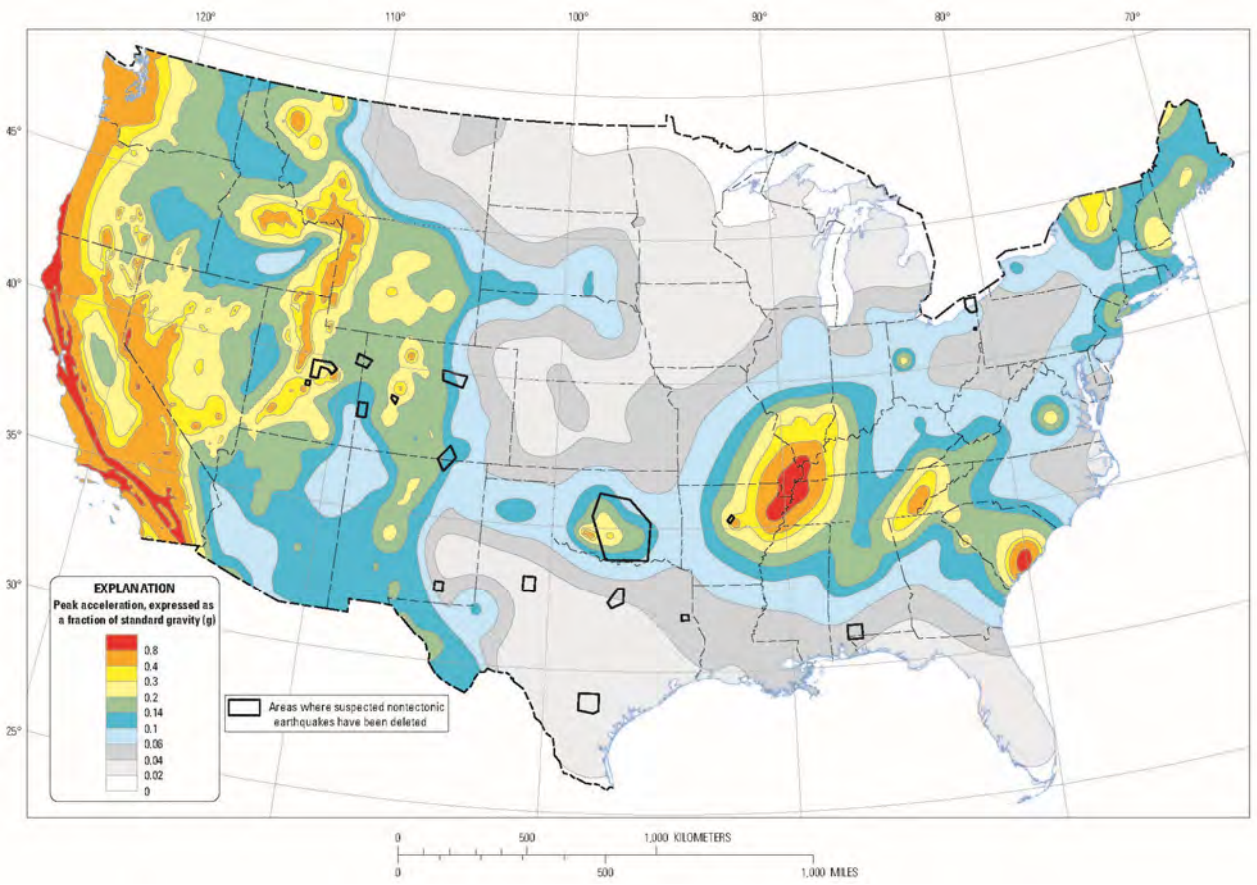


Figure 2.4 Peak Ground Acceleration (%g) with 2 Percent Probability of Exceedance in 50 Years

Hazard History

Even though the greatest seismicity in the United States occurs along the Pacific Coast, major earthquakes have also occurred in the central and eastern United States. The last earthquake to cause appreciable damage in the eastern United States occurred in 1886 near Charleston, South Carolina. It had an estimated magnitude of 6.5 to 7, which is equal to an intensity of X, and was felt over an area of two million square miles. Even in Maryland, the felt intensity from this earthquake was between a magnitude of 4 to 5. [19]

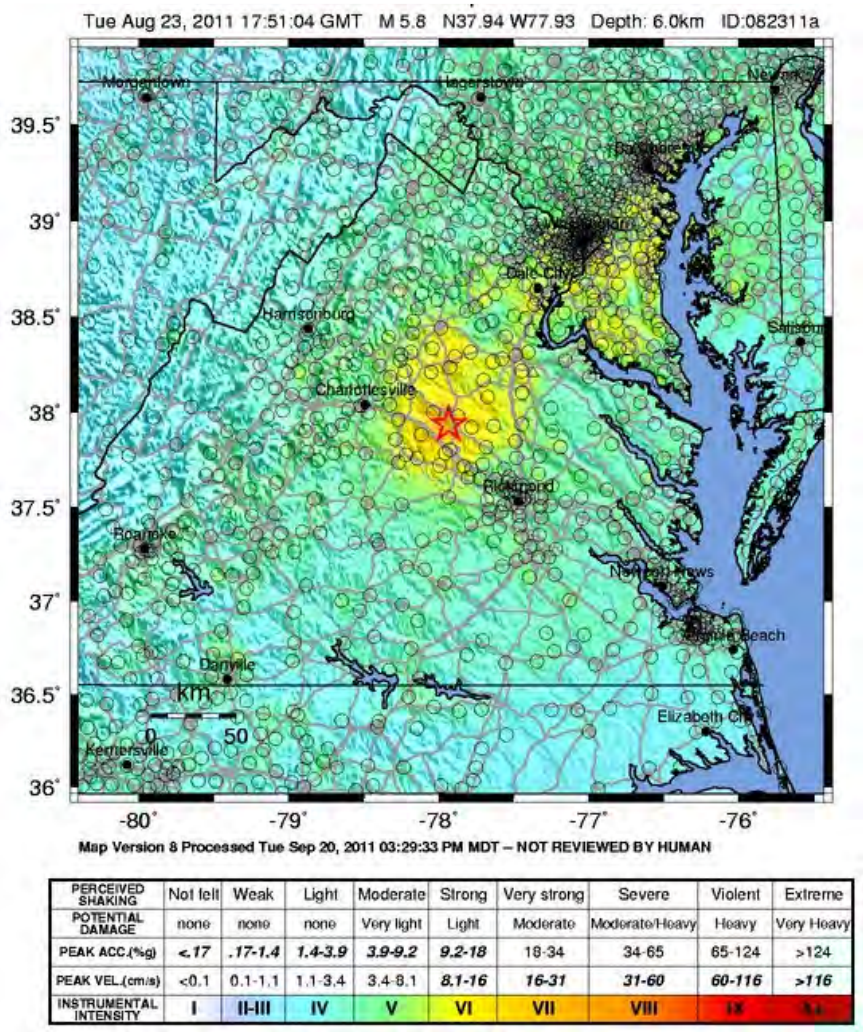
No significant earthquake incidents have been recorded in Frederick County. Several earthquakes in adjacent states have been felt in Maryland. These out of state areas with more seismic activity include southwestern Virginia, central Virginia, and the Atlantic seaboard northward from Wilmington, Delaware.[20]

The following are some notable earthquake events that have been felt in Frederick County:

- On August 23, 2011, a 5.8 magnitude and MMI of VII earthquake occurred in Louisa County, Virginia. The earthquake was felt by many in Maryland, with light to moderate perceived shaking within the county. Frederick County Public Works Division, Department of Highway and Facility Maintenance records did not indicate any loss or require infrastructure repairs due to this event. Figure 2.5 shows the shaking intensity of this event.
- On July 16, 2010, an earthquake of 3.6 magnitude was reported in Montgomery County, Maryland. The epicenter was located near Germantown, Md., but was felt across the entire

region. A 2.0-magnitude aftershock was reported about 8.5 miles away at 5:16 a.m. in the area of Barnesville Road in Boyds, Maryland. No damage was reported.[21]

- An earthquake 12 miles south of Lancaster, Pennsylvania with a 4.1 on the Richter Scale was felt in much of Maryland on Easter Sunday, April 22, 1984. Most notable effects in Maryland were in the northeastern part of the state.[22]
- Several earthquakes with a magnitude of 2.7 were located in Union Bridge (northeast of Frederick County) occurred in 1902 and 1903. Based on the magnitude and distance, these events may have been felt in the County, although this is unlikely.[23]



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Figure 2.5 August 23, 2011 ShakeMap (Source: USGS Earthquake Hazards Program)

Landslides

Overview and Profile

Landslides include a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over-steepened slope is the primary reason for a landslide, there are other contributing factors:

- Erosion by rivers, glaciers, or ocean waves creates over-steepened slopes
- Rock and soil slopes are weakened through saturation by snowmelt or heavy rains

- Earthquakes create stresses that make weak slopes fail; earthquakes of magnitude 4.0 and greater have been known to trigger landslides
- Volcanic eruptions produce loose ash deposits, heavy rain, and debris flows
- Excess weight from accumulation of rain or snow, stockpiling of rock or ore from waste piles or from man-made structures may stress weak slopes to failure.

Slope material that becomes saturated with water may develop a debris flow or mud flow. The resulting slurry of rock and mud may pick up trees, houses, and cars, blocking bridges and tributaries and causing flooding along its path. Landslides occur in every state and United States territory. Any area composed of very weak or fractured materials resting on a steep slope can and will likely experience landslides.

Landslides are often prompted by the occurrence of other disasters. Floods or long duration precipitation events create saturated, unstable soils that are more susceptible to failure. The forces of earthquakes can also cause landslides.

Landslides constitute a major geologic hazard because they are widespread, occurring in all 50 states, and causing $1 to 2 billion in damages and more than 25 fatalities annually. Landslides pose serious threats to highways and structures that support fisheries, tourism, timber harvesting, mining, and energy production as well as general transportation. Landslides commonly occur with other major natural disasters such as earthquakes and floods that exacerbate relief and reconstruction efforts. Expanded development and other land uses have increased the incidence of landslide disasters.

Based on the Landslide Overview Map of the Conterminous United States from USGS, Frederick County is in an area of high susceptibility and moderate incidence.[24] Please see Appendix C, Figure C.4, for the Frederick Landslide Susceptibility Map.

Hazard History

On April 16, 2011, Maryland Route 550 was closed for three months because of a landslide between Kelbaugh Road and Eylers Valley Flint Road. The landslide was caused by spring rains. One lane was open in June 2011 and full restoration was finished on July 27, 2012.

Karst/Land Subsidence

Hazard Profile

Land subsidence occurs when large amounts of groundwater have been withdrawn from certain types of rocks, such as limestone, dolomite, and gypsum. The rock compacts because the water is partly responsible for holding the ground up. When water is withdrawn, the rock falls in on itself.

Common causes of land subsidence from human activity are pumping water, oil, and gas from underground reservoirs; dissolution of limestone aquifers (sinkholes); collapse of underground mines; drainage of organic soils; and initial wetting of dry soils (hydrocompaction). Land subsidence occurs in nearly every state.

The zone of dewatering influence, established by the state, identifies areas around quarries in which quarry owners can be held liable should the quarry adversely affect adjacent properties' well water supplies and/or sinkhole formation. Based on information from the Maryland Department of the Environment, Mining Program,

> "There are certain regions of the state where dewatering of surface mines may interfere with water supply wells and may contribute in some instances to sudden subsidence of land known as sinkholes. It is the intent of the surface mine law (Environment Article 15-801--15-834) to provide an added measure of protection to

those property owners that may be impacted by the surface mine operations by establishing a zone of influence around the quarry."[25]

Land subsidence is usually not observable because it occurs over a large area. When land subsidence is isolated in a small area, it appears as a sinkhole.

Frederick County has been known to have a number of sinkholes. In 2002, a study titled *Stratigraphy-Karst Relationships in the Frederick Valley of Maryland* was conducted by David K. Brezinski and James P. Reger of the Maryland Geological Survey. The following information has been extracted from this study.[26]

> Karst features are present in strata of Triassic, Ordovician, and Cambrian age in the Frederick Valley of Maryland. The Frederick Valley of Maryland's western Piedmont represents the state's second largest karst terrain. Although the largest is located in eastern Washington County and is known as the Hagerstown Valley or Great Valley, the Frederick Valley has had more incidences of catastrophic collapse and active subsidence than its larger neighbor. The Frederick Valley is a lowland region that stretches from the Potomac River northward to Woodsboro in northern Frederick County, an area of approximately 400 square kilometers. The Maryland Geological Survey, in conjunction with the Maryland State Highway Administration, has been conducting detailed geologic mapping along with karst feature identification. This report is the preliminary results of that study which is currently in progress.
>
> This study recognized and recorded three types of karst features: closed depressions, active sinkholes, and karst springs. By far the most common feature recognized were closed depressions, otherwise known as dolines. Dolines are defined as features that are recognizable topographic lows towards which the surrounding area is inclined and can be from a few meters to 100 meters in width. The second category of karst features recorded is active sinkholes. These features are differentiated from depressions by the recognition of recent activity, or an open throat. The third category of karst features is springs. Depressions are by far the most common feature recorded, making up nearly 74 percent of all the readings. While active sinkholes comprised nearly 25 percent of the features, springs were a distant third making up only 1.3 percent of all karst features.
>
> Approximately 1,179 karst features have been identified in the southern part of the Frederick Valley (Buckeystown, Point of Rocks and Frederick 7.5 minute quadrangles).

The Engineering Aspects of Karst map in Appendix C, Figure C.5, shows areas containing distinctive surficial and subterranean features developed by solution of carbonate and other rocks and characterized by closed depressions, sinking streams, and cavern openings. This dataset is a digital version of USGS Open File Report 2004-1352 (scale 1:7,500,000). USGS karst mapping shows a northwestern karst region and a southern portion of Frederick County. The southern region is located east of Maryland Route 351, west of Interstate 270, and extending north into Frederick City. The karst topography is classified as fissures, tubes, and caves generally less than 1,000 feet (300 meters) long, 50 feet (15 meters) or less in vertical extents, and in gently dipping to flat-lying beds of carbonate rock.[27]

To supplement the USGS karst mapping cited above, Figure C.7 in Appendix C shows generalized rock types in Frederick County. The karst region in Figure C.5 is shown in Figure C.7 as a limestone rock formation that extends farther to the northeast into Woodsboro. The limestone, dolomite, and marble bedrock in Frederick County are considered to be areas at risk for karst features because they are formed by the slow dissolution of calcium and magnesium oxides in the rock types.

Hazard History

The frequency of sinkholes that impact Frederick County has increased in recent years. The Frederick County DPW has identified and repaired hundreds of sinkholes along county roads during the past 10 years. Since 2010, DPW has spent $210,086 on the repair of utilities and roads related to sinkholes. Events before 2010 are included in Appendix A. Two of the most significant incidents are described below:

- On February 15, 2015, a large sinkhole formed on Inspiration Drive near a pressure sewer system. As a result, the sewer system was closed for two weeks during repair/reconstruction. Total costs associated with the repair of the facility and roadway was $175,758. [28]
- On June 6, 2012, the Maryland State Highway Administration (SHA) closed the ramp from South Street to eastbound Interstate 70, as well as the left lane along Interstate 70 to repair a sinkhole that developed in the median. The sinkhole was about 20 feet deep by 10 feet wide and 10 feet long.

The Maryland SHA identified between 250 and 300 sinkholes in Frederick County; 154 of these can be identified as distinct locations and have been mapped. Several sites in particular have experienced numerous and sometimes large sinkholes. As mapped by DPW, these include:

- Devilbiss Bridge Road/Railroad
- Spectrum Drive
- New Horizons Way
- Westview Drive
- Crestwood Boulevard
- English Muffin Way
- New Design Road
- Technology Way

Given the geology of the area, it is likely that that data used to create the sinkhole activity map is missing activity north of Frederick City in Walkersville and Woodsboro.

Climate Change as an Amplifier of Natural Hazards

Overview

Governments throughout the United States share a common goal of ensuring the safety, health, and welfare of their communities. Meeting this goal and maintaining the integrity of essential public services requires that governments anticipate trends and changes that could affect their environment, economy, and community wellbeing. Climate change may eventually affect communities and government functions in a variety of ways; government services, assets, operations, and policy areas may all be impacted to some extent. More obvious impacts may include an increased risk for extreme events such as drought, storms, flooding, landslides, and wildfires; more heat-related stress; the spread of existing or new vector-born disease into a community; and increased erosion and inundation of low-lying areas along coastlines.[29] Working proactively to address the anticipated impacts to these extreme events can help mitigate against future damages to both infrastructure and human life.

According to the American Planning Association, new conditions and certain extreme experiences in recent years have brought the issue of climate change into the forefront for planners, lawmakers, and the public. Clear evidence exists of climate change leading to specific, measurable effects ranging from Arctic melting and sea level rise to heightened storm and drought frequency and/or severity. These conditions make it imperative that planners and policymakers work immediately to implement new policies to address climate change.[30]

The effects of climate change may be felt through any of the atmospheric, wildfire, hydrologic, and geologic hazard categories detailed within this hazard mitigation plan. It can increase the hazards that currently exist and introduce new hazards not previously experienced in the county. As such, it is imperative that Frederick County continue to be proactive by including climate change as an amplifier that may exacerbate natural hazards.

Observed Trends

In 2013, NOAA produced a technical report entitled *Regional Climate Trends and Scenarios for the U.S. National Climate Assessment,* a series of nine climate documents (one for the contiguous United States and eight for each region) which include descriptions of observed historical climate trends, as well as future predictions and scenarios. In this context, Maryland is included as part of the Northeast Region (also includes ME, NH, VT, MA, RI, CT, NY, NJ, PA, DE, WV, and Washington DC). According to the report, temperatures across the region increased on average 0.16 degrees Farenheit per decade between 1895 and 2011. Increases were observed in every season, although the most significant upward trend has been during the winter months. Precipitation across the region has also been on the rise, particularly since 1970, and during the fall months. The frequency of extreme precipitation (heavy downpours) has also increased significantly over this time period. Given this regional trend, Frederick County and the National Capital Region should continue to strongly consider climate change and its associated effects on future planning.

Future Trends

According to *Regional Climate Trends and Scenarios for the U.S. National Climate Assessment,* average temperatures in the Frederick County region are expected to be anywhere from 2.5-4.5 degrees Farenheit warmer by the middle of the century (2041-2070) and 3.5-7.5 degrees Farenheit warmer by the latter part of the century (2071-2099), depending on the emissions scenario (or continued rate of greenhouse gas emissions into the future). These values are compared to average temperatures during the period from 1970-1999 (Figure 2.6). The County is also expected to experience more extreme heat, with an average of 15-18 more days annually above 95 degrees Farenheit by the middle of the 21st Century (2041-2070) as compared to the latter part of the 20th Century (1981-2000).

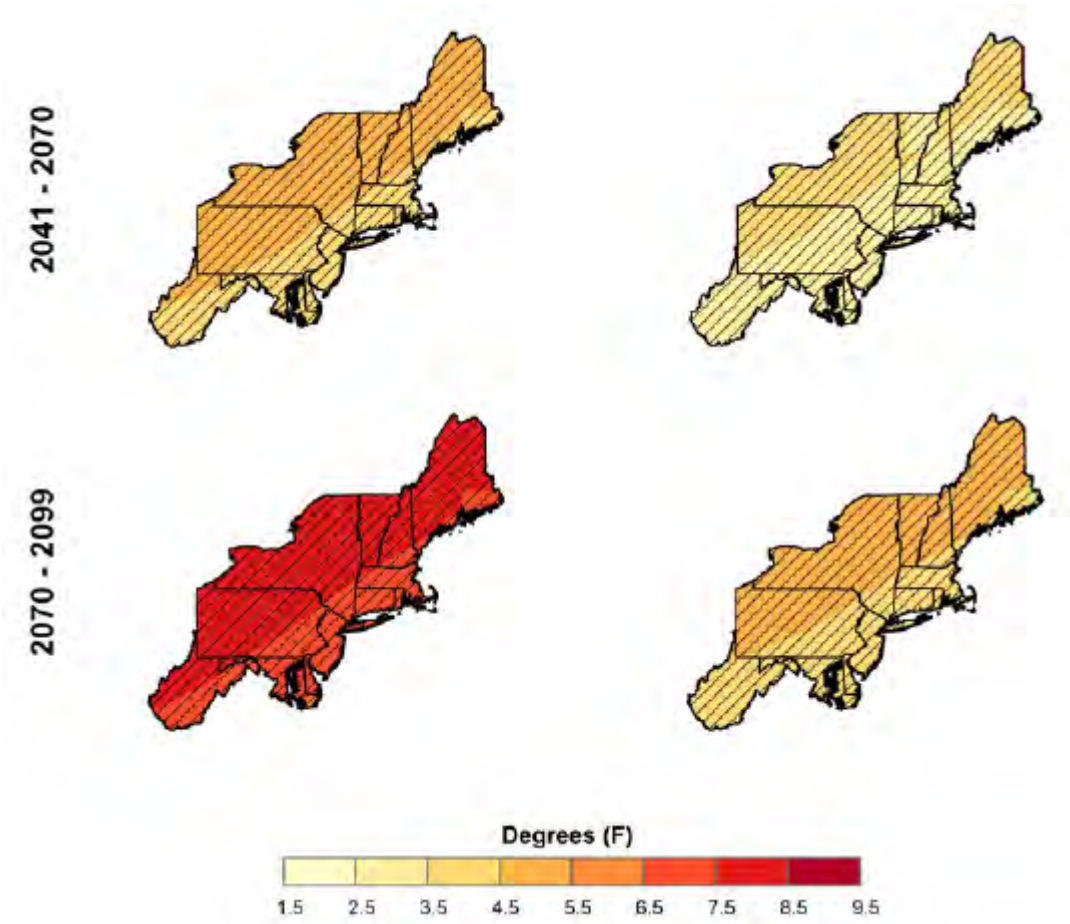


Figure 2.6 Projected Temperature Increase Across the Northeastern United States. The high emissions scenario (A2) is displayed on the left and the low emission scenario (B1) is displayed on the right. Source: NOAA, 2013.

The Maryland Commission on Climate Change reported in their *Comprehensive Assessment of Climate Change Impacts to Maryland* that if emissions do not decrease, annual precipitation changes will be felt during both summer and winter seasons, with heavier precipitation occurring in the winter, and longer and dryer summer seasons occurring with decreased rainfall. The most noticeable percentage increase will occur during the winter months.

According to *Regional Climate Trends and Scenarios for the U.S. National Climate Assessment,* average annual precipitation is expected to increase 0 to 3 percent by the middle of the century (2041-2070) and 3 to 6 percent by the latter part of the century (2070-2099), relative to the 1971-1999 average. However, more of this precipitation is expected to fall as extreme, high intensity events, with an 18 to 21 percent increase in the annual number of days with greater than 1 inch of precipitation by the middle of the century (2041-2070), relative to the 1980-2000 average (Figure 2.7). Precipitation may also be less consistent throughout the year, with both more extended wet and dry periods. Such changes in precipitation patterns could lead to more frequent flash flooding, as well as more frequent and extended droughts.

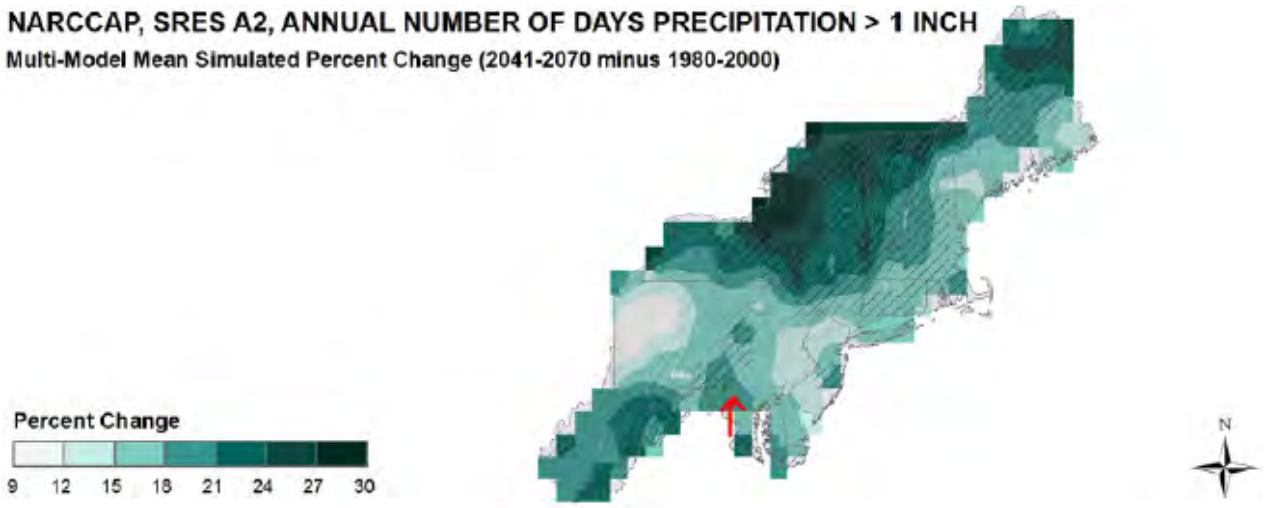


Figure 2.7 Percent Change in Annual Number of Days with Precipitation > 1 inch for the Northeast Region by 2041-2070, relative to 1980-2000. The red arrow marks the approximate location of Frederick County, which mostly lies within the range of an 18 to 21 percent increase. Source: NOAA, 2013.

The projected change in the climate has significant global effects as well. Some concerns are:

- The risk of drought and the frequency, intensity, and duration of heat waves are expected to increase
- More extreme precipitation is likely, increasing the risk of flooding
- If the world's average temperature warms only an additional 2.7 to 4.5 degrees Fahrenheit above pre-industrial levels, an estimated 20 to 30 percent of known plant and animal species would be at increasingly high risk of extinction[31]
- Sea level rise has the potential to increase coastal flooding during storm events and even permanently inundate low-lying areas in many coastal and island areas. Given Frederick County's location, impact from sea level rise should be limited.

Regional Initiatives

Frederick County has a unique opportunity to address the issue of climate change and the potential affects it may have on the county. Both Maryland and the Metropolitan Washington Council of Governments (MWCOG) have been engaged in climate change initiatives. On April 20, 2007, then-Governor Martin O'Malley signed Executive Order 01.01.2007.07 establishing the Maryland Climate Change Commission (MCCC).[32] One of the early successes of the Commission was the publication of the Climate Action Plan in August 2008. This report summarizes the impact of climate change on the state, establishes a greenhouse gas and carbon footprint reduction strategy, and discusses ways to decrease Maryland's vulnerability to climate change. Although much of the report's focus is on sea level rise and the potential impact to Maryland's coastal communities, the report also examines the issues surrounding Maryland's agricultural and forested communities. This, in particular, applies directly to Frederick County.

In 2009, Maryland passed the Greenhouse Gas Emissions Reduction Act (GGRA). The law requires the State to develop and implement a Plan (the GGRA Plan or the Plan) to reduce greenhouse gas (GHG) emissions 25 percent from a 2006 baseline by 2020. The GGRA Plan, completed in 2012, puts the State on track to achieve this reduction, while also creating jobs and improving the State's economy.[33] In 2010, the Frederick County Board of Commissioners released the Greenhouse Gas Emissions Inventory Report, which addresses emissions attributed to county

government operations, as well as the community at large. The County has also set a goal to reduce greenhouse gas emissions 25 percent below the 2007 baseline by 2025.[34]

In 2009, the MCCC began work on a report called *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change*. While Phase I of the report focused on reducing risk from coastal storms and sea level rise, Phase II, published in 2011, was aimed at building societal, economic, and ecological resilience. The Strategy outlines adaptation measures to reduce the impacts of climate change, including increased temperature and changes in precipitation in the following sectors: Human Health; Agriculture; Forest and Terrestrial Ecosystems; Water Resources; and Population Growth and Infrastructure.[35]

Climate Change Adaptation Measures for Frederick County

As stated in *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments*, an increasing amount of physical evidence points to the fact that climate change is already in motion as a result of the greenhouse gases accumulated in the atmosphere to date, particularly since the 1950s. It is projected that the climate through the middle of the 21st century will be driven by present-day greenhouse gas concentrations. Given these projections, reducing greenhouse gas emissions will limit the severity of long-term future impacts, but will do little to alter the near-term changes already set in motion.[36]

Recognizing its increasing vulnerability to climate change, the 2009 Frederick County Hazard Mitigation Plan Update was among the first at the time to include climate change, and this work has been carried forward for inclusion in this plan update as well. Several sectors of Frederick County may be directly impacted by the effects of climate change. These sectors may include: hydrology and water resources, agriculture, biodiversity, forests, recreation, energy, transportation, and human health and welfare. When assessing the County's risk and vulnerability to the natural hazards mentioned in this plan, the County should consider the potential impacts from exacerbated weather events on the sectors above. The *National Capital Region's Climate Change Report* looked specifically at jurisdictions in Maryland and rated the risks associated with severe weather events potentially worsened by climate change.[37] As shown in Table 2.14, Frederick County is ranked high or medium-high for risks associated with severe weather events (except tidal/coastal flooding). Each of these events are also analyzed and prioritized as hazards chosen by the Frederick County HMPC for inclusion in this plan.

Table 2.14 Risks by Jurisdiction in Maryland Associated with Severe Weather Events Potentially Exacerbated by Climate Change

Event	High Risk	Medium-High Risk
Drought	**Frederick,** Montgomery, Howard, Carroll, Baltimore City and County, Harford	None
Extreme Heat	Baltimore City	**Frederick**, Prince George's, Charles, Calvert, Howard, Anne Arundel, Harford
Flash/River Flooding	**Frederick**	Montgomery, Carroll, Baltimore County, Anne Arundel
Thunderstorm	**Frederick**, Montgomery, Anne Arundel	Prince George's, Carroll, Howard, Baltimore County, Harford
Tornado	**Frederick**, Anne Arundel	Prince George's, Charles, Carroll, Baltimore County, Harford
Winter Weather (Snow and Ice)	None	**Frederick**, Montgomery, Prince George's, Anne Arundel, Howard, Carroll
Tidal/ Coastal Flooding	None	Anne Arundel, Calvert

Water Resources

Water quantity, quality, and infrastructure will be affected by climate change. Precipitation is expected to become more variable, which may impact water quality and stress water supply infrastructure. Although average precipitation is anticipated to increase slightly, this is most likely to occur in winter and not during summer months of maximum demand. As the climate changes, one of the more immediate impacts will be the change in Frederick County's water resources. Not only might it affect the overall water supply, it might also affect water quality and increase flood risks. According to the U.S. Environmental Protection Agency (EPA), evaluating the impacts of climate change on water resources is challenging because water availability, quality, and stream flow are sensitive to changes in temperature and precipitation. Additionally, seasonal fluctuations are a major factor in availability and stream flow in Frederick County. Other important factors include increased demand for water caused by population growth, changes in the economy, development of new technologies, changes in watershed characteristics, and water management decisions.[38] Mitigation measures that could reduce the potential impact to water resources include:

- Revising water storage and release programs for reservoirs
- Adopting crops and cropping practices that are robust over a wider spectrum of water availability
- Adjusting water prices to encourage conservation and the expansion of water supply infrastructure
- Supporting water transfer opportunities[39]

Additionally, in the Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change report, the MCCC recommends:

- Ensuring long-term safe and adequate water supply for humans and ecosystems through practices such as demand management and water conservation
- Reducing the impacts of flooding and stormwater through practices such as removal of vulnerable or high-hazard water supply and treatment infrastructure[40]

Flooding

As global temperatures increase, the atmosphere will contain more moisture, which will likely enhance the intensity of heavy downpours.[41] More intense rainfall may increase peak flooding in urban environments, including areas of Frederick County.[42] An increase in rainfall may negatively affect infrastructure such as storm water runoff, crop irrigation systems, the transportation network, and local housing developments.

Mitigation measures to reduce potential flooding impacts include:

- Conduct a detailed risk assessment of flood hazards modeling the potential effects of climate change
- Analyze storm water management plans and predict changes in flood impacted areas
- Develop "future conditions" floodplain maps for climate change scenarios and use those maps for zoning and planning

Agriculture

As mentioned in the drought section (p. 29), Frederick County has a significant agricultural community. Warmer temperatures and more variable precipitation will likely lead to changes in crop and animal production and pest management. The impacts of climate change on the

agricultural community of Frederick County could be economically devastating. Crop production may increase initially, but decline later in the century if emissions are not reduced and more intense droughts occur. The longer growing season and higher carbon dioxide levels in the atmosphere are likely to increase crop production modestly during the first half of the century. Later, crop production is likely to decrease due to heat stress and summer drought.[43] As temperatures rise, some crops may experience a decrease in the length of the growing season resulting in less revenue for the county and its citizens. Increased temperatures also may increase crop water demand putting extra strain on the county's water resources. Prolonged periods of drought may negatively impact the growing season of some Frederick County crops, as well.

Measures to consider that could mitigate against the possible effects of climate change on the Frederick County agricultural community include:

- Conduct a detailed drought risk assessment accounting for the potential effects of climate change
- Educate agricultural community about the benefits of growing crops that are more drought resistant
- Adopt crops and cropping practices that are robust over a wider spectrum of water availability

Additionally, in the Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change report the MCCC recommends:

- Increasing crop diversity, protecting against pests and disease, and intensifying water management
- Strengthening applied research, risk communication, and technical support
- Enhancing existing Best Management Practices (BMPs) and land conservation targets[44]

Transportation Infrastructure

An area of public service that may be overlooked when mitigating against the impacts of climate change is transportation infrastructure. As temperatures rise and the severity and frequency of storm events increase, storm runoff may overwhelm various culverts and bridges throughout Frederick County, which could make roads and bridges impassible.

Strategies to mitigate against future damages to transportation infrastructure include:

- Consider climate change impacts on natural hazards in establishing design levels for new and replacement infrastructure
- Perform routine maintenance and replacement of infrastructure components damaged by extreme temperatures and storms
- Provide opportunities to shift passenger trips from cars to public transportation, biking, and walking, and freight trips from trucks to rail (and possibly ships) to help to reduce on-road travel
- Develop infrastructure for cleaner and more climate friendly fuels and engine technologies[45]

Human Health and Welfare

Climate change will likely cause increases in heat stress, reduced air and water quality, and shifts in vector-borne disease risk. The impacts of climate change on human health will vary and depend on, among other factors, an individual's sensitivity and exposure to a given threat and capacity to

adapt. A warmer climate could result in increased cases of vector-borne diseases, such as West Nile virus, and stronger, more frequent heat waves. Locally, there is also a correlation between heat waves and the occurrence of high ozone days. Generally, the hotter the temperature, the more favorable the conditions are for ozone-producing chemical reactions in the air, which can lead to an increase in asthma cases and exacerbation of chronic respiratory diseases. Mitigation measures to consider should include:

- Encouraging private transportation users to reduce emissions of greenhouse gases
- Providing public education programs to warn of the dangers of extreme heat and high ozone conditions
- Monitoring the health status of the community

Additionally, in the Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change report the MCCC recommends:

- Conducting vulnerability assessments to gain a better understanding of risks and inform preventative responses
- Integrating impact reduction strategies into State and local planning practices
- Streamlining and revising data collection and information dissemination channels[46]

Table 2.15 cross-references the sectors discussed above to the natural hazards that may be exacerbated by climate change. The table shows how exacerbated hazards may manifest themselves as vulnerabilities for Frederick County.

Table 2.15 Climate Change Risks and Vulnerabilities

Natural Hazard	Relative Risk	Sector			
		Water Resources	Agriculture	Transportation Infrastructure	Human Health and Welfare
Drought/Extreme Heat	High	Strains on water supply Adverse water quality affects	Shorter growing season Reduced crop yield	Increased roadside erosion Failure of roadway asphalt	Increased food costs Food shortages Heat strokes Respiratory problems Reduced air quality
Flash/River Flooding/ Thunderstorm	High	Adverse water quality affects	Damage to crops Damage to irrigation systems	Increased roadside erosion Failure of roadway asphalt	Flooding deaths Injury from debris Population displacement

Natural Hazard	Relative Risk	Sector			
		Water Resources	Agriculture	Transportation Infrastructure	Human Health and Welfare
Winter Weather (Snow & Ice)	Med-High	Groundwater availability	Damage to crops	Failure of roadway asphalt	Injury from debris Population displacement

Hazard Identification Summary

As shown in Table 2.3, the county experienced approximately 821 natural hazard events from 1950 to May 2015 based on NCDC storm events data. Table 2.16 summarizes the NCDC data events as well as the County-provided hazard data and losses, capturing additional local knowledge. The data source for each summary is provided as part of the period of record. Sinkholes/karst, wildfire, and thunderstorms are the most common hazards in the county, followed by severe winter weather and flooding. The total property damage to the county by all of the profiled hazards during this period was almost $56.7 million and total crop damage was approximately $36.5 million.

Hazard Frequency

Based on the hazard history and profiles of the aforementioned hazards, the hazard frequency (also called the expected annual number of events) was calculated based on the available data, as shown in Table 2.16. The hazard frequency was calculated by dividing the number of events observed by the number of years. The higher the number, the more likely an event (or multiple events) will happen in a given year.

Table 2.16 Historical Occurrence and Recorded Damage (as of August 2015)

Hazard Type	Period of Record	Total Events	Expected Annual Number of Events	Property Damage (2015$)	Crop Damage (2015$)
Atmospheric Hazards					
Extreme Heat	1993 - 2015 NCDC	34	1.48	$0	$0
Thunderstorm	1950 - 2015 NCDC	341	5.17	$3,805,851	$103,067
Extreme Wind	1993 - 2015 NCDC	48	2.09	$704,023	$130,589
Hailstorms	1950 - 2015 NCDC	64	.97	$5,495	$19,235
Lightning	1993 - 2015 NCDC	23	1.00	$1,164,012	$0
Severe Winter Weather	1993 - 2015 NCDC	149	6.48	$365,170	$21,774
	2010 - 2015 DPW	-	-	$11,711,682	$0
Tornado	1950 - 2015 NCDC	35	0.53	$5,110,661	$75,400
	2010 - 2015 DPW	-	-	$13,831	$0
Tropical Storm/Hurricane	1996 - 2015 NCDC	2*	0.09	$5,259	$0
	2010 - 2015 DPW	-	-	$387,522	$0
Hydrological Hazards					
Drought	1993 - 2015 NCDC	12	0.52	$0	$36,139,325
Flooding	1993 - 2015 NCDC	136	5.91	$32,878,245	$60,320
	2010 - 2015 DPW	-	-	$349,446	$0
Dam Failure	USACE	0	0	$0	$0

Hazard Type	Period of Record	Total Events	Expected Annual Number of Events	Property Damage (2015$)	Crop Damage (2015$)
Wildfire Hazards					
Wildfire/Wildland Urban Interface	2010 - 2015 AMS	94	15.67	$0	$0
	1998 - 2010 DNR	382	21.22	$0	$18,882
Geological Hazards					
Earthquake	USGS	0	0	$0	$0
Landslide	USGS	0	0	$0	$0
Karst/Land Subsidence	2004 - 2015 DPW	300	25	$210,086	0
Total				**$56,711,283**	**$36,568,592**

*5 tropical storm/hurricane events were categorized as floods or not recorded in the NCDC database. Expected number of annual events is .16 when taking into consideration the 7 known events since 1972.

CHAPTER 3 - VULNERABILITY ANALYSIS/LOSS ESTIMATION

Summary of Changes

The 2015 plan update consolidates, updates, and streamlines content from the 2009 vulnerability assessment, which in turn built on the original 2004 analysis. The foundation of the 2009 assessment remained valid; each hazard was re-evaluated and a new analysis performed, when applicable. The new analysis included: 1) determining annualized number of hazard events and losses using the National Climatic Data Center (NCDC) and other data sources where available; 2) updating the assessment of vulnerability and risk based on new data; 3) new analysis with updated critical facilities data; 4) creation of hazard maps specific to the county; and 5) providing overall hazard comparisons (presented at the end of this chapter).

In addition, each section of the plan was reformatted to improve clarity, and new maps and imagery have been included. The 2011 Maryland State Hazard Mitigation Plan was reviewed as part of this update and, when applicable, information from the plan has been cited as such.

Overview

As discussed in Chapter 2, steps three and four of risk assessment are the vulnerability assessment and loss estimation. A detailed explanation of each step can be found below.

Vulnerability Analysis

The hazard identification for Frederick County indicates that some of the hazards warrant a vulnerability analysis because of their frequency of occurrence or because they have caused major damage in Frederick County and its municipalities. The vulnerability assessment uses the information generated in the hazard identification to identify locations in which residents of Frederick County could suffer the greatest injury or property damage in the event of a disaster. This assessment identifies the effects of hazard events by estimating the relative exposure of people, buildings, and infrastructure to hazardous conditions.

Loss Estimation

The last step of the risk assessment, loss estimation, involves estimating losses from hazard events and requires a full range of information and accurate data. The loss estimation process helps answer the question “How will the community’s assets be affected by the hazard event?” The most convenient way to express the expected losses is in terms of dollars. Rough estimates are provided where available.

There are a number of site-specific and structure-specific characteristics that determine a building’s ability to withstand hazards. Site-specific characteristics that have a direct impact on losses incurred can depend on the exposure to hazards, first-floor elevation, number of stories, construction type, foundation type, age and condition of structure, use of structure, and structure contents.

It should be noted that areas and total structures vulnerable to various hazards have been calculated based on available county data.

Building Stock

Using 2010 U.S. Census data derived from Hazus-MH, there are an estimated 85,141 buildings in the County. The total building replacement value is $33.4 billion, with $20.4 billion in contents exposure. Approximately 91.2 percent of the buildings are residential housing (Table 3.1), with the dollar exposure estimated at more than $27.6 billion (Table 3.2). Commercial buildings in the County have a total dollar exposure of approximately $3.2 billion, as displayed in Table 3.2.

Approximately 56 percent of the County's building stock was built after 1980; 31.1 percent was built between 1940 and 1979, and the remaining 12.9 percent was built before 1940. The majority of the buildings in Frederick County are wood frame construction. A quarter of the buildings in the county are reinforced/unreinforced masonry.

Table 3.1 Building Count by Occupancy (Source: Hazus-MH)

Occupancy	Count	% of Total
Residential	77,638	91.2%
Commercial	4,574	5.4%
Industrial	1,544	1.8%
Agricultural	452	0.5%
Religious	559	0.7%
Government	203	0.2%
Education	171	0.2%
Total	**85,141**	100%

Table 3.2 Building Exposure by Occupancy (Source: Hazus-MH)

Occupancy	Building Exposure ($1,000)	% of Total	Contents Exposure ($1,000)	% of Total
Residential	$27,645,779	82.8%	$13,824,480	67.7%
Commercial	$3,295,187	9.9%	$3,511,200	17.2%
Industrial	$1,311,273	3.9%	$1,818,997	8.9%
Agricultural	$117,472	0.4%	$117,472	0.6%
Religious	$471,199	1.4%	$471,199	2.3%
Government	$232,139	0.7%	$267,257	1.3%
Education	$327,822	1.0%	$404,783	2.0%
Total	$33,400,871	100%	$20,415,388	100%

In addition to the building stock, building footprints were provided by the Frederick County GIS Department. According to this data, there are 166,660 structures in Frederick County with a total exposure value of $28.7 billion. The Unincorporated County has 118,136 structures with a total exposure valure of $15.2 billion. The jurisdicition with the next largest number of structures is the City of Frederick, which has 28,247 structures with an exposure value of $10.9 billion. Table 3.3 summarizes the number of structures and exposure for each participating municipality.

Table 3.3 Building Footprints and Exposure (Source: Frederick County GIS)

Municipality	Total # Building Footprints	Total Market Value Exposure
Brunswick	3,755	$354,310,200
Burkittsville	197	$13,519,180
Emmitsburg	1,351	$200,870,350
Frederick City	28,247	$10,940,436,934
Middletown	2,326	$359,034,590
Mount Airy	1,994	$316,415,110
Myersville	898	$105,909,990
New Market	745	$93,321,690
Rosemont	306	$28,854,860
Thurmont	4,351	$432,713,010
Unincorporated County	118,136	$15,287,458,274
Walkersville	3,515	$523,532,910
Woodsboro	839	$90,064,720
Total	**166,660**	**$28,746,441,818**

Critical Facilities

To assess Frederick County's vulnerability, an inventory of its structures and critical facilities was performed. Critical facilities are those that warrant special attention in preparing for a disaster and that are vital in maintaining community function. Frederick County has prepared an inventory of critical facilities that includes emergency response facilities such as: law enforcement, fire, and emergency medical services (EMS) stations; hospitals, nursing homes, and care facilities; schools; local government buildings; and important transportation facilities, including airports, parks, water treatment plants, and waste water treatment plants.

Table 3.4 indicates a total of 301 facilities in Frederick County and its municipalities that are deemed critical. Of these, 81 facilities are located in the City of Frederick, and 138 facilities are dispersed in the unincorporated areas of the county. In terms of facility type, there are 28 nursing and health care related facilities in the county and 64 public schools. Parks are considered part of the critical assets in the county, the majority of which are categorized as neighborhood parks, followed by community parks. There is a small percentage of parks classified as district, regional, and natural resource parks. Table A.1 in Appendix A provides detailed information for each facility in the hazard zones.

Figure C.1 in Appendix C shows all of the mapped critical facilities and park locations in the County. This information was provided by the Frederick County Department of Emergency Preparedness and Interagency Information Technologies Division GIS team.

Table 3.4 Critical Facilities (Source: Frederick County GIS)

Locality	Colleges and Universities	Fire/EMS	Law Enforcement	Library	Nursing and care facility	Post Office	Public Facility	Public School	Radio Tower	Transportation	WTP/WWTP	Total
Brunswick	0	2	1	1	0	1	3	3	1	1	2	15
Burkittsville	0	0	0	0	0	1	1	0	0	0	0	2
Emmitsburg	0	2	1	1	1	1	1	1	0	0	0	8
Frederick City	1	7	3	1	14	4	25	16	4	1	5	81
Middletown	0	1	0	1	0	1	1	4	0	0	1	9
Mount Airy	0	0	0	0	0	0	0	1	0	0	2	3
Myersville	0	1	0	0	0	1	1	1	0	0	2	6
New Market	0	1	0	0	0	1	1	3	0	0	0	6
Rosemont	0	0	0	0	0	0	0	0	0	0	0	0
Thurmont	0	4	1	1	1	1	1	4	0	0	2	15
Walkersville	0	2	0	1	2	1	1	4	0	0	1	12
Woodsboro	0	1	0	0	0	1	1	1	0	0	2	6
Unincorporated County	1	12	2	2	10	12	8	26	5	3	57	138
Total	2	33	8	8	28	25	44	64	10	5	74	301

Lifeline Inventories

Table 3.5 shows the Transportation System Lifeline Inventory that was derived from the Hazus-MH database. The replacement value for highways in the county was approximately $2 billion, and for airports, $322 million. The total transportation system lifeline replacement value was estimated at $2.4 billion.

Lifelines have been categorized as follows:

- A highway transportation system consists of roadways, bridges, and tunnels
- A railway transportation system consists of tracks, bridges, tunnels, stations, fuel, dispatch, and maintenance facilities
- A light railway transportation system consists of tracks, bridges, tunnels, stations, fuel, dispatch, and maintenance facilities; the major difference between light rail and rail systems is the power supply, where light rail systems operate with direct current substations
- A bus transportation system consists of urban stations, fuel facilities, and dispatch and maintenance facilities
- Port and harbor transportation systems consist of waterfront structures, cranes/cargo handling equipment, warehouses, and fuel facilities
- A ferry transportation system consists of waterfront structures, passenger terminals, warehouses, fuel facilities, and dispatch and maintenance facilities

- An airport transportation system consists of control towers, runways, terminal buildings, parking structures, fuel facilities, and maintenance and hanger facilities

Table 3.5 Transportation System Lifeline Inventory (Source: Hazus-MH)

System	Component	Locations/Segments	Replacement Value ($1,000)
Highway	Bridges	152	$197,782
	Segments	126	$1,803,406
	Tunnels	0	$0
	Sub Total	278	$ 2,001,188
Railways	Bridges	0	$0
	Facilities	1	Unavailable
	Segments	78	$107,119
	Tunnels	2	Unavailable
	Sub Total	81	$107,119
Light Rail		0	$0
Bus		1	$2,158
Ferry		0	$0
Port		0	$0
Airport	Facilities	8	$43,164
	Runways	9	$276,923
	Sub Total	36	$ 322,245
Total		**377**	**$2,430,552**

Table 3.6 shows the Utility System Lifeline Inventory derived from Hazus-MH 2010 U.S. Census data. The replacement value for potable water facilities in the County is approximately $65.9 million, and that of wastewater facilities is $1.5 billion; the replacement value for each system's distribution lines is unknown. The total utility system lifeline replacement value is estimated near $1.6 billion (excluding distribution lines).

Utility systems addressed in the Hazus-MH methodology include potable water, wastewater, natural gas, oil, electrical power, and communication systems, which are defined as follows:

- A potable water system consists of pipelines, water treatment plants, control vaults and control stations, wells, storage tanks, and pumping stations
- A wastewater system consists of pipelines, wastewater treatment plants, control vaults and control stations, and lift stations
- A natural gas system consists of pipelines, control vaults and control stations, and compressor stations
- An oil system consists of pipelines, refineries, control vaults and control stations, and tank farms
- An electrical power system consists of generating plants, substations distribution circuits, and transmission towers
- A communication system consists of communications facilities, communications lines, control vaults, switching stations, radio/TV stations, weather stations, or other facilities

Table 3.6 Utility System Lifeline Inventory (Source: Hazus-MH)

System	Component	Locations/Segments (km)	Replacement Value ($1,000)
Potable Water	Distribution Lines	12,758.2	Unknown
	Facilities	2	$65,934
Waste Water	Distribution Lines	7654.9	Unknown
	Facilities	23	$1,516,482
Natural Gas	Distribution Lines	5,103.3	Unknown
Electrical Power	Facilities	1	$10,890
Communication	Facilities	11	$1,089
Total		**37 facilities 25,516.4 km total distribution lines**	**$1,594,395**

Vulnerability Analysis

As part of this chapter, each of the profiled hazards have been prioritized based on several factors (Table 3.7) including the frequency of occurrence (probability/history), amount of damage caused, potential for significant damage, and the committee's knowledge of the potential impacts of the hazard as part of the analysis. The extent of vulnerability analysis was driven by availability of data and established methodology for vulnerability analysis.

2015 Hazard Priorities Update

During the 2015 update kick-off meeting, committee members discussed and identified hazards of concern. Chapter 2 describes the hazard identification and re-classification process completed for the 2015 plan update. Each of the hazards profiled were considered using the hazard priority criteria. For the update, hazard specific sections have been added for all of the profiled hazards, regardless of the overall priority score. The initial rankings were reviewed during the second HMPC meeting on September 15, 2015. The committee reviewed the rankings and decided to weight the ranking criteria to de-emphasize warning time and emphasize probability and vulnerability.

Priority Ranking Criteria

As discussed in the planning process, the final priority rankings were updated using HMPC feedback in addition to the four criteria summarized below. Each criteria identifies and categorizes the comparative probability and potential vulnerability for the identified hazards in Frederick County. The framing criteria/questions are shown in the numbered list below, and Table 3.7 provides the thresholds for each of the risk levels.

The five main parameters include:

1. Probability/History: Has the hazard occurred in the area before, and if so, how often based on the historical record? *Weighting Factor: 0.35*
2. Vulnerability: If the expected event does occur, how many people might be killed, injured, or contaminated, and how much property might be damaged or destroyed (e.g., the percent of people or property vulnerable to the hazard)? *Weighting Factor: 0.25*
3. Maximum Threat: What is the worst-case scenario of the hazard and how bad can it get? What will the loss of life and property damage be if the worst-case scenario occurs (e.g., the percent of the community impacted by the hazard)? *Weighting Factor: 0.10*
4. Warning Time: How much time is the community given to prepare for an event? *Weighting Factor: 0.10*

5. Ranking in Previous Plan: The ranking from the 2009 Frederick County Hazard Mitigation Plan was factored in the 2015 ranking. *Weighting Factor: 0.20*

Table 3.7 Hazard Priority Criteria

Probability/History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking
Unlikely No documented occurrence with annual probability <0.01	**Negligible** 1 to 10% of people or property	**Isolated** < 5% of community impacted	**Extended** Three days or more	**Low**
Somewhat Likely Infrequent occurrence with at least one documented event and annual probability between 0.5 and 0.01	**Limited** 10 to 25% of people or property	**Small** 5 to 25% of community impacted	**Limited** 2 days	**Medium**
Likely Frequent occurrence with at least 2 documented events and annual probability between 1 and 0.5	**Critical** 25 to 50% of people or property	**Medium** 25 to 50% of community impacted	**Minimal** 1 day	
Highly Likely Common events with annual probability >1	**Catastrophic** >50% of people or property	**Large** >50% of community impacted	**No Notice** < 24 hours	**High**

Each hazard was assessed based on the five criteria above and assigned an overall hazard priority based on a 5 point priority scale. The overall priority rankings include: Low, Medium-Low, Medium, Medium-High, and High.

Atmospheric Hazards

Extreme Heat

The priority hazard ranking process determined extreme heat to be a medium priority hazard in Frederick County. The hazard priority for extreme heat has been elevated from low in 2009 to medium for the 2015 plan update. There have been 34 recorded extreme heat events in the County since 1993, resulting in an expected annual number of events of 1.48. No historic damages have been documented. Table 3.8 outlines the hazard rankings for each of the hazard priority criteria related to extreme heat.

Table 3.8 Extreme Heat Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Highly Likely Common events with annual probability >1	**Negligible** 1 to 10% of people or property	**Large** Common events with annual probability >1	**Extended** Three or more days	Low	Medium

Thunderstorm

The priority hazard ranking process determined thunderstorm to be a medium priority hazard in Frederick County. The hazard priority for thunderstorm has decreased from high in 2009 to medium for the 2015 plan update. There have been 341 recorded thunderstorm events in the county since 1950, resulting in an expected annual number of events of 5.17. Based on historic damages of $3,908,918, Frederick County may experience on average $59,226 in damages annually. Table 3.9 outlines the hazard rankings for each of the hazard priority criteria related to thunderstorm.

Table 3.9: Thunderstorm Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Highly Likely Common events with annual probability >1	**Negligible** 1 to 10% of people or property	**Small** 5 to 25% of community impacted	**Minimal** 1 day	**High**	**Medium**

Extreme Wind Events

The priority hazard ranking process determined extreme wind to be a medium-high priority hazard in Frederick County. The hazard priority for wind events decreased from high in 2009 to medium-high for the 2015 plan update. Table 3.10 outlines the hazard rankings for each of the hazard priority criteria related to extreme wind.

Table 3.10 Extreme Wind Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Highly Likely Common events with annual probability >1	**Limited** 10 to 25% of people or property	**Small** 5% to 25% of community impacted	**Minimal** 1 day	**High**	**Medium-High**

Background

The primary hazard caused by winds is the transport of debris, which can cause casualties and property loss or even the dislodging of mobile homes from their structures or vehicles. High winds may also cause damage to poles and lines carrying electric, telephone, and cable television service. As mentioned earlier, older structures built before 1940 could be more susceptible to wind damage.

Older critical facilities are vulnerable to wind damage due to the age of construction and possible poor condition, especially in the more rural and isolated areas of the County. It is important to identify specific critical facilities and assets that are most vulnerable to the hazard. Evaluation criteria include the age of the building (and what building codes may have been in effect at the time of construction), type of construction, and condition of the structure (i.e., how well the structure has been maintained).

Loss Estimation

There have been 48 extreme wind events recorded in the county since 1993, resulting in an expected annual number of events of 2.09. Based on historic damages of $834,612, Frederick County may experience on average $36,287 in damages annually. Losses due to wind can also

occur from tropical storm/hurricane events. A more detailed analysis is included in the Tropical Storm/Hurricane section.

Future Trends

As development and population density increase in the County, wind may present an increased threat to the people and structures. As society becomes more dependent on electricity, extreme winds can result in greater impact by causing power outages, either through direct damage to power lines and poles or by damage to the power grid.

Mitigation Measures

The entire county can be affected by wind hazards. Strong winds can rip roofs off houses, overturn buildings, and cause total failure of poorly constructed structures. Certain structures are particularly susceptible to damage and overturning in extreme wind events, including:

- Aged, dilapidated, and poorly constructed buildings;
- Buildings not constructed to applicable building codes;
- Manufactured housing units; and
- Houses with gable-ended roofs.

Special attention should be paid to securing these structures by strapping and anchoring foundations.

Hailstorm

The priority hazard ranking process determined hailstorms to be a medium-low priority hazard in Frederick County. The hazard priority for hailstorm has decreased from medium in 2009 to medium-low for the 2015 plan update. There have been 64 hailstorm events recorded in the county since 1950, resulting in an expected annual number of events of 0.97. Based on historic damages of $24,730, Frederick County may experience on average $375 in damages annually. Table 3.11 outlines the hazard rankings for each of the hazard priority criteria related to hailstorm.

Table 3.11 Hailstorm Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Somewhat Likely Infrequent occurrence with at least one documented event and annual probability between 0.5 and 0.01	**Negligible** 1 to 10% of people or property	**Isolated** < 5% of community impacted	**Minimal** 1 day	**Medium**	**Medium-Low**

Lightning

The priority hazard ranking process determined lightning should remain a medium priority hazard in Frederick County. Lightning is common in the County but vulnerability is negligible; therefore, no additional vulnerability assessment is warranted. Lightning events are typically recorded only if they result in damage to structures or injury to people. There have been 23 lightning events

recorded in the NCDC database for the county since 1993, resulting in an expected annual number of events of 1.0. Based on historic damages of $1,164,012, Frederick County may experience on average $50,609 in damages annually. Table 3.12 outlines the hazard rankings for each of the hazard priority criteria related to lightning.

Table 3.12 Lightning Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Highly Likely Common events with annual probability >1	**Negligible** 1 to 10% of people or property	**Isolated** < 5% of community impacted	**Minimal** 1 day	**Medium**	**Medium**

Severe Winter Storms

The priority hazard ranking process determined severe winter storms should remain a high priority hazard in Frederick County. Table 3.13 outlines the hazard rankings for each of the hazard priority criteria related to severe winter storm.

Table 3.13 Severe Winter Storm Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Highly Likely Common events with annual probability >1	**Critical** 25 to 50% of people or property	**Large** >50% of community impacted	**Limited** 2 days	**High**	**High**

Background

Vulnerability to the effects of winter storms on buildings depends on the age of the building (and the building codes in effect at the time of construction), type of construction, and condition of the structure (i.e., how well it has been maintained, materials used, etc.).

The entire County can be impacted by snow, ice and, extreme cold, although there is generally greater snow accumulation in the north and west due to higher elevations, and more blowing and drifting in the east and south. Severe winter storms result in the loss of utilities, increases in traffic accidents, impassable roads, and lost income since normal commuting can be hindered. Snow and ice can be extremely hazardous because visibility is reduced and surface accumulation reduces traction and strains power lines, roofs, and other structures. Severe winter storms have been and will continue to be a significant threat to the economic and social well-being of Frederick County. Disruptions of emergency and other essential services and critical facilities are the main threats to people and property.

Severe storm activity poses a significant threat to unprotected or exposed lifeline systems. Generally, commercial power networks are very susceptible to interruption from snow and ice conditions. Other utilities, including underground pipelines, may be impacted if not protected from exposure.

All critical facilities in the County are vulnerable to the effects of severe winter storms due to the potential disruption of services and transportation systems as well as possible structure failure due to heavy snow loads.

Approximately 12.9 percent of the occupied housing units in Frederick County were built prior to 1940, according to the 2010 U.S. Census. A large percentage of structures in the Cities of

Frederick and Brunswick and the Towns of Rosemont and Emmitsburg were built prior to 1940. These may be in well-preserved, older neighborhoods; however, some of the older structures may not be in a condition to weather these storms due to factors such as poor building quality orantiquated plumbing, and would require adequate measures to ensure that they are brought up to code to mitigate damages from severe storms.

Loss Estimation

As recorded by NWS NCDC, there have been 149 severe winter weather events in the county since 1993, resulting in an expected annual number of events of 6.48. Based on historic damages from NCDC and Frederick County DPW of $12,098,626, Frederick County may experience on average $526,027 in winter weather-related costs (road clearing and damages) annually.

Mitigation Measures

- Stocking adequate quantities of road treatment materials and pre-treating roads expedites and improves road clearing.
- Public education concerning safe driving and driving only if it is required, and also stocking up on food, water, batteries, and other supplies will prepare people for storms.

Tornadoes

The priority hazard ranking process determined tornadoes to be a medium priority hazard in Frederick County. The hazard priority for tornado events decreased from high in 2009 to medium for the 2015 plan update. Table 3.14 outlines the hazard rankings for each of the hazard priority criteria related to tornadoes. As described in the priority ranking criteria section, vulnerability assessments have been completed for hazards receiving a significant or critical priority level. Due to the HMPC concern regarding this hazard, a qualitative vulnerability assessment has been completed for tornadoes.

Table 3.14 Tornado Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Likely Frequent occurrence with at least 2 documented events with annual probability between 1 and 0.5	**Negligible** 1 to 10% of people or property	**Isolated** < 5% of community impacted	**No Notice** < 24 hours	**High**	**Medium**

Background

Tornadoes have occurred in Frederick County in the past and are expected to occur in the future. Tornadoes often result in buildings with missing roofs, uprooted road signs, fallen power lines and trees, destroyed homes and water towers, and damaged cars. For example, the tornado that hit the County in August 1999 did extensive damage to trees in Eastview, Walnut Springs, Shookstown, and Fort Detrick. Some trees fell onto cars and houses, and a few homes under construction were damaged. Yellow Springs Road was closed for several hours until power and telephone poles blocking the road could be cleared.

Loss Estimation

There are no standard loss estimation models and tables for tornadoes. Exposure data estimates the number of structures at risk. Manufactured homes are particularly vulnerable to tornadoes.

According to 2009 - 2013 U.S. Census American Community Survey estimates, 0.9 percent of the occupied housing stock (791 structures) in Frederick County was a mobile home or other type of manufactured housing. Census tracts 751000 (south City of Frederick), 751600, 751700 (Libertytown), 752500 (Burkittsville), and 753100 (east of Thurmont) have more than 35 manufactured homes each.

There have been 35 tornado events in the County recorded since 1950, resulting in an expected annual number of events of 0.53 (about one every two years). Based on historic damages from NCDC and Frederick County DPW of $5,199,892, Frederick County may experience on average $78,577 in damages annually.

Future Trends

The impact of tornadoes primarily depends upon their occurrence in developed areas; tornadoes in undeveloped areas may cause damage only to a few trees and are often unreported. As development and population in the County increase, a larger number of structures and people may be subject to tornadoes.

Mitigation Measures

The most important factor in the vulnerability assessment is how likely structures are to fail when subjected to wind loads that exceed their design or to flying debris that penetrates the building. In general, building damages can range from cosmetic to complete structural failure, depending on wind speed and location of the building with respect to the tornado path, and can be analyzed by a structural engineer.

Measures to reduce damages from tornadoes include proper anchoring and strapping of buildings to their foundations, and designing shelters and other critical facilities for appropriate wind speeds. Warning and notification systems are also extremely important in order to give people adequate time to get to a safe place if a tornado is imminent. People should be made aware of what the warnings mean and know what to do in case a warning is issued before the onset of severe weather or tornadoes.

<u>Tropical Storm/Hurricane</u>

The 2015 priority hazard ranking process determined tropical storm/hurricane should remain a medium priority hazard in Frederick County. Historic occurrences of tropical storms/hurricanes indicate that Frederick County is at risk of experiencing future events that may severely impact the county. Typically, the damages caused by tropical storms/hurricanes are due to the storm's extreme winds and rainfall.

Table 3.15 Tropical Storm/Hurricane Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Somewhat Likely Infrequent occurrence with at least once documented event with annual probability between 0.1 and 0.01	**Limited** 10 to 25% of people or property	**Medium** 25 to 50% of community impacted	**Extended** Three or more days	**Medium**	**Medium**

Loss Estimation

The Hazus-MH Hurricane Model from FEMA's loss estimation software was used to determine losses to Frederick County from a hurricane that made landfall on the East Coast. In terms of general building stock damage, Frederick County may incur an approximate annualized loss of $238,000 in direct building damages (estimated costs to repair or replace the damage caused to the building and its contents) based on the hurricane event itself.

It should be noted that Hazus-MH is considered one of many planning tools used by states and local governments. Other tools should be considered in developing the hazard analysis and risk assessment for local communities. In some cases, other tools and methodologies may be more useful than Hazus-MH in the performance of a hazard analysis and risk assessment.

Based on the maximum sustained wind speeds provided by FEMA's Benefit Cost Analysis module, it can be assumed that Frederick County has a 5 percent chance of experiencing tropical storm force winds annually. There is a 2.5 percent chance of experiencing a Category 1 hurricane in a given year, and a .02 percent chance of experiencing anything greater than a Category 1.

An alternate way to measure probability is to use past occurrences. Based on presidential disaster declarations and the NCDC database, there have been 7 tropical storm/hurricane events recorded in the County since 1972 resulting in an expected annual number of events of 0.16. Based on historic damages of $382,781 from NCDC and Frederick County DPW, Frederick County on average may experience $17,077 annually in tropical storm/hurricane damages and transportation road clearing costs. Table 3.15 outlines the hazard rankings for each of the hazard priority criteria related to tropical storms/hurricanes.

Hydrological Hazards

Drought

The priority hazard ranking process determined drought should remain a medium priority hazard in Frederick County. Table 3.16 outlines the hazard rankings for each of the hazard priority criteria related to drought. As described in the priority ranking criteria section, vulnerability assessments have been completed for hazards receiving a significant or critical priority level.

Table 3.16 Drought Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Likely Frequent occurrence with at least 2 documented events with annual probability between 1 and 0.5	**Negligible** 1 to 10% of people or property	**Medium** 25 to 50% of community impacted	**Extended** Three or more days	**Medium**	**Medium**

Background

Those who rely on surface water (reservoirs and lakes) and subsurface water (groundwater) are usually not adversely affected by a drought. A short-term drought that persists for 3 to 6 months may have little impact on these areas, depending on the characteristics of the hydrologic system and water use requirements. Droughts of longer duration affect areas that are dependent on stored

surface or subsurface supplies while the impacts of a drought may be less in agricultural areas as rain quickly replenishes soil moisture. Groundwater users who are often the last to be affected by drought during its onset may also be the last to experience a return to normal water levels. The length of a recovery period is a function of the intensity of the drought, its length, and the quantity of precipitation as the drought ends.

Loss Estimation

Agriculture is highly vulnerable to drought. According to the 2012 U.S. Agricultural census, there are approximately 181,512 acres of farmland in Frederick County, meaning that approximately half of the County is dedicated to agriculture, making up 10 percent of Maryland's farm area.

There have been 12 multi-year droughts in the county since 1993, resulting in an expected annual number of events of 0.52. Based on historic crop damages of $36,139,325, on average Frederick County may experience $1,571,275 annually in drought related crop damages.

Future Trends

As business and population growth continue in Frederick County, the potential impacts of a prolonged drought grow significantly. Continued residential and commercial development in towns coupled with the need to acquire additional sources of water will result in a diminishing water supply.

If the County is unsuccessful in attracting the majority of its new growth to more developed areas, new development could encroach on rural areas. This potential conversion of rural land for residential use would be of great concern to the County due to its implications for loss of agricultural and forest land, open space, and rural character, and the need for additional sources of water.

Mitigation Measures

Identifying the first stages of drought and helping to conserve water will help mitigate drought to an extent. In the future, there is also the potential for limiting population growth and development dependent on available groundwater. Mitigation management for drought is a proactive process; however, most of the process has occurred at the state level.

In Maryland, the Governor's Water Conservation Advisory Committee recommended actions for the four drought stages:

Stage 1: Normal Conditions (green)

Stage 2: Watch (Yellow) 5-10 percent reduction goal

- Drought conditions evaluated biweekly
- MDE media office works with local TV and radio stations to issue frequent drought updates to public
- MDE increases monitoring of any problems incurred by water systems
- Utilities or local governments may impose restrictions more stringent than the state guidelines
- Water systems activate Water Conservation Plans
- Water systems aggressively pursue leak detection surveys and repair programs
- Reduce water usage for main flushing, street flushing, and park irrigation
- Business and industries activate water emergency plans

- Homeowners, government facilities, businesses, and industry should reduce water use for irrigation purposes

Stage 3: Warning (Orange) 10-15 percent reduction goal

- Drought conditions evaluated on a weekly basis
- Residences, businesses, and industry voluntarily comply with nonessential water use restrictions
- MDE media office works with local TV and radio stations to issue periodic notification of drought measures, and to increase public awareness of water conservation
- MDE continues to monitor problems incurred by water systems
- Utilities or local governments may impose restrictions more stringent than the state guidelines
- Water systems actively implement water conservation measures
- Water systems individually contact industrial users to reduce water usage
- Water systems discontinue flushing water lines, fire hydrants, and distribution equipment
- Facility managers for government buildings identify leaks and accelerate maintenance and/or repairs
- Encourage business and industry to irrigate with treated wastewater in accordance with health guidelines

Stage 4: Emergency (Red) 15-20 percent reduction goal

- Drought conditions evaluated at least weekly
- Implement mandatory restrictions on nonessential water uses
- MDE media office works with local TV and radio stations to issue daily drought updates to public
- Establish Drought Hotline
- Utilities or local governments may impose restrictions more stringent than the state guidelines
- MDE and water systems notify consumers of severity of water shortage
- Water systems conduct field surveillance of abuses, leaks, etc.
- Local police and/or water systems execute enforcement of water conservation restrictions
- Water systems verify availability of alternate water source or interconnection
- Residences comply with mandatory nonessential water use restrictions
- Business and industry comply with water conservation plans to reduce water use by at least 10 percent
- Business and industry evaluate need for reduced hours of operation[47]

Flash Floods and Flooding

The priority hazard ranking process determined flash floods and flooding should remain a high priority hazard in Frederick County. Table 3.17 outlines the hazard rankings for each of the hazard

priority criteria related to flooding. As described in the priority ranking criteria section, vulnerability assessments have been completed for hazards receiving a significant or critical priority level.

Table 3.17 Flash Floods and Flooding Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Highly Likely Common events with annual probability >1	**Critical** 25 to 50% of people or property	**Small** 5% to 25% of community impacted	**Minimal** 1 day	**High**	**High**

Background

As discussed in the Hazard Identification chapter of this plan, Frederick County periodically experiences flooding from seasonal rainstorms, flash floods, and hurricanes. There are two types of floods experienced in the area. During a riverine flood, water slowly climbs over the edges of a stream or riverbed and spreads to the surrounding area. Flash flooding, the more dangerous type of flooding, is discussed in Chapter 2. Localized flooding results when constant and sometimes heavy rains occur, overloading drainage ways and flowing into streets and low-lying areas. A map of frequently flooded roadways in Frederick County can be found in Appendix C.

Observing the slow rise of water along with an area-wide flood warning usually gives adequate time to evacuate; however, because the rainfall associated with flash flooding is so intense and fast moving, it is not as easy to predict when a flash flood will occur. The NWS issues flood and flash flood watches and warnings to keep the public informed of hazardous situations and the need to evacuate. The National Weather Service's Doppler radar, which can track rainfall over very small areas, is also an invaluable resource available to those living or working near flood hazards.

As discussed in Chapter 2, areas identified as vulnerable to flooding are depicted on the effective Frederick County and Incorporated Areas NFIP maps, which were adopted by the County and incorporated communities (Appendix C, Figure C.2). The FEMA flood zones represent the areas susceptible to the 1 percent annual chance flood (often referred to as the "100 year flood"), and the 0.2 percent annual chance flood ("500 year flood"). The 1 percent annual chance flood is known as the "base flood" and has at least a 1 percent chance of occurring annually and at least a 26 percent chance of occurring over the life of a typical 30 year mortgage. FEMA designates this area as the SFHA and requires flood insurance for properties in this area as a condition of a mortgage backed by federal funds. The County's rivers, 1 percent annual chance floodway, and 1 percent and 0.2 percent annual chance flood areas are available for review at www.co.frederick.md.us/planning. As noted previously, a map of Frederick County's floodplain can be found in Appendix C, Figure C.[1]

Frederick County and several of its incorporated communities have developed strong floodplain management programs that exceed the minimum NFIP regulatory standards. Most notably, in the unincorporated areas of the County, new development is not permitted in the County's designated floodplains unless approved by the County Board of Appeals. While new development is being

[1] The 1 percent annual chance regulatory floodway is the area identified on an NFIP map that represents the portion of the floodplain that carries the majority of the flood flow and is often associated with high velocity flows and debris impact. It is the part of the stream channel plus that portion of the overbanks that must be kept free from encroachment in order to discharge the 1 percent annual chance flood without increasing flood levels by more than 1.0 foot (some states specify a smaller allowable increase).

guided away from known areas at risk of flooding, Frederick County, nonetheless, has existing neighborhoods that periodically flood.

Vulnerability to flash flooding is difficult to determine because local terrain, soil conditions, and construction play a role in how much storm water can percolate into the soil, be accommodated by waterways, or cause flash flooding. Flood vulnerability is described in terms of the community assets that lie in the path of floodwaters.

Critical facilities are vulnerable to flash flooding, but their vulnerability is dependent on their siting relative to specific terrain and soil types and the amount of excess runoff from neighboring and upstream areas. Since flash floods frequently occur outside of delineated SFHAs, there is no absolute certainty that future development in a specific location in the county would not be subject to flash floods. Roads subject to repetitive flooding are shown on the SFHA map in Appendix C, Figure C.2 and Figure C.7.

Loss Estimation

Geographic Information Systems (GIS), digital FEMA Flood Insurance Rate Maps (DFIRMs), FEMA's Hazus-MH, and other modeling tools have been used to identify structures in the County at risk of flooding. The key results of these analyses are summarized in the sections that follow, and summarized in Table 3.18. All estimates of population, buildings, and infrastructure at risk, as well as loss estimates that follow, are based on modeling and data from Hazus-MH. Due to population growth and increased development, all estimates of the numbers of vulnerable structures and losses may under-estimate risk at the present time.

Table 3.18 Flood Loss Estimates (in U.S. $1,000s)

Recurrence Interval	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Direct Loss	Total
1 percent annual chance	$142,202	$144,351	$4,859	$177	$324	$57	$1,403	$1,741	**$295,114**
0.2 percent annual chance	$194,282	$205,634	$7,883	$249	$459	$95	$1,908	$2,296	**$412,806**

One Percent Annual Chance Flood

According to Hazus-MH, approximately 457 buildings (5 commercial and 452 residential) would be damaged by a 1 percent annual chance flood. The total building related losses would be $295 million. One percent of the estimated losses was related to the business interruption of the region. Damage to residential structures made up 48.07 percent of the total loss. Given an average household size of 2.72 and 452 residential structures affected, approximately 1,229 people would be impacted by a 1 percent annual chance flood.

The September 2014 Monocacy Watershed Discovery Report indicates that there are high loss areas along the Monocacy and Carroll Creek in Frederick County. Approximately 61 percent of the County's population is located within the Monocacy Watershed.

Two-tenths Percent Annual Chance Flood

According to Hazus-MH, approximately 655 buildings (8 commercial and 647 residential) would be damaged by a 0.2 percent annual chance flood. The total building related losses would be $412 million. Two percent of the estimated losses were related to business interruption in the region.

Damage to residential structures made up 48.95 percent of the total loss. Given an average household size of 2.72 and 647 residential structures affected, approximately 1,759 people would be impacted by a 0.2 percent annual chance flood. Appendix C, Figure C.3 summarizes the 0.2 percent annual occurrence flood loss by census block.

In addition to the Hazus-MH analysis, building footprints were intersected with the SFHA. Table 3.19 shows the number of structures in each of the SFHA zones and the associated risk and vulnerability. Total market value exposure is the total building value in the municipality, and the total market value vulnerability indicates the value of the structures in the SFHA. Approximately 2.26 percent of the building footprints in the County are located in a mapped flood zone, accounting for 1.7 percent of the building exposure for the County. The majority of the structures are located in Zone A. Nearly 2 percent (1.7 percent) of the building value exposure is in the SFHA.

The Monocacy Watershed Discovery Report (2014) indicates that no new structures have been added to the mapped floodplain following the adoption of the 2007 FIRMs.

Table 3.19 Number of Building Footprints in Flood Zones

Name	Total # Building Footprints	Building Footprints in Zone A	Zone AE	Zone AO	0.2% Annual Chance Flood	Total Market Value Vulnerability	Total Market Value Exposure
Brunswick	3,755	81	0	0	0	$1,399,940	$354,310,200
Burkittsville	197	0	0	0	0	$0	$13,519,180
Emmitsburg	1,351	0	36	0	36	$5,483,880	$200,870,350
Frederick City	28,247	3	367	3	424	$199,358,380	$10,940,436,934
Middletown	2,326	7	0	0	0	$105,400	$359,034,590
Mount Airy	1,994	0	0	0	0	$0	$316,415,110
Myersville	898	3	0	0	0	$0	$105,909,990
New Market	745	0	0	0	0	$0	$93,321,690
Rosemont	306	1	0	0	0	$0	$28,854,860
Thurmont	4,351	19	67	0	7	$5,938,520	$432,713,010
Unincorporated County	118,136	1,750	799	0	109	$283,496,810	$15,287,458,274
Walkersville	3,515	2	35	0	0	$4,634,650	$523,532,910
Woodsboro	839	15		0	0	$2,415,680	$90,064,720
Total	**166,660**	**1,881**	**1,304**	**3**	**576**	**$502,833,260**	**$28,746,441,818**

There have been 136 flood events recorded in the county since 1993, resulting in an expected annual number of events of 5.91. Based on historic damages of $33,288,011 from NCDC and Frederick County DPW, Frederick County on average may experience $1,432,112 annually in flood-related costs, including debris removal and damage.

Critical Facilities

A critical facility is necessary to preserve the welfare and quality of life in the County, or fulfills important public safety, emergency response, and/or disaster recovery functions.

Many public and commercial facilities serve vital functions for communities, which, if interrupted due to flooding, would severely impact citizens. Some facilities also house large numbers of people who would experience difficulty if required to evacuate before or during a severe flood.

Since flooding can prevent access to a critical facility even if the facility is elevated or floodproofed above the flood level, knowing what facilities are located in existing flood hazard areas and avoiding building any new critical facilities in flood hazard areas is critically important to ensuring

public safety. Thirteen critical facilities in Frederick County are located in the 1 percent annual chance floodplain and 1 is located in the floodway. Facilities located in the SFHA are shown in Table 3.20.

Table 3.20 Critical Facilities Located in the SFHA

Facility Type	Facility Name	Site Address	Flood Zone	Floodway
Fire/EMS	Independent Hose Company	310 Baughmans Lane	AE	Y
Public Facility	Animal Health Lab	1840 Rosemont Ave	X-shaded	N
Public Facility	Citizen Services Division Building	401 Sanger Ave	X-shaded	N
Public School	Middletown Primary	403 Franklin Street	A	N
Radio Tower	Bridgeport Radio Tower	Bridgeport Road	A	N
Transportation	Brunswick MARC Station	100 S. Maple Ave	A	N
Transportation	Point of Rocks MARC Station	4000 Clay St	A	N
*WTP/WWTP	City of Brunswick WWTP	S Maple Ave	A	N
*WTP/WWTP	Middletown Sewers	Ivy Hill Ln	A	N
*WTP/WWTP	Thurmont WWTP	96 E Moser Road	A	N
*WTP/WWTP	Frederick County Crestview	Quail Knob Lane	A	N
*WTP/WWTP	Frederick County Fountaindale	Beech Tree Lane	AE	N
*WTP/WWTP	WWTP	Greenfield Drive	AE	N
*WTP/WWTP	Frederick County Point of Rocks	Rock Hall Road	A	N
*WWTP	Frederick County Ballenger Creek	7303 Marcies Choice Ln	AE	N

Water and wastewater treatment plants, by their nature, must be near a body of water and thus are typically located in the floodplain.

Flood Insurance Coverage

Table 3.21 summarizes community participation in the NFIP in Frederick County. The current effective maps for the county are from September 2007, with preliminary products due to become effective in December 2016. As of August 2015, there were 624 flood insurance policies in effect throughout the County, with total annual premiums of $641,539 covering more than $156.9 million in property. The majority (159) of these policies are for properties in the unincorporated areas of Frederick County. The loss statistics from FEMA's Community Information System (CIS) database for the County indicate that there have been 197 flood insurance claims processed by the NFIP since 1978. These statistics are summarized in Table 3.22. As shown in the table, flood hazard boundary maps (FHBMs) were not issued for all communities.

Table 3.21 Community Participation in the National Flood Program (as of August 2015)

Community Name	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Date of NFIP Entry
Frederick County	07/19/74	06/01/78	09/19/07	06/01/78
Brunswick, City of	06/28/74	01/07/77	09/19/07(M)	01/07/77
Burkittsville, Town of	N/A	09/19/07	09/19/07	08/16/10
Emmitsburg, Town of	03/29/74	09/17/80	09/19/07	09/17/80
Frederick, City of	10/18/74	06/15/78	09/19/07	06/15/78
Middletown, Town of	01/14/77	10/23/81	09/19/07(M)	10/23/81
Mount Airy, Town of	N/A	09/19/07	(NSFHA)	05/27/14
Myersville, Town of	12/06/74	12/15/78	09/19/07(M)	12/15/78
New Market, Town of	N/A	09/19/07	09/19/07	12/31/07
Rosemont, Village of	N/A	09/19/07	09/19/07	08/30/10
Thurmont, Town of	06/28/74	09/28/79	09/19/07	09/28/79
Walkersville, Town of	06/28/74	09/30/80	09/19/07	09/30/80
Woodsboro, Town of	01/13/78	12/15/78	09/19/07(M)	12/15/78

Table 3.22 Flood Insurance Policy Statistics and Claims (as of August 2015)

Community Name	No. of Policies	Total Premium	Total Coverage	Total Claims since 1978	Total Payments
Brunswick	14	$8,534	$2,441,200	7	$27,686
Burkittsville	No data available				
Emmitsburg	13	$6,409	$2,768,700	13	$40,951
Frederick City	159	$144,643	$41,747,500	24	$97,443
Middletown	8	$3,203	$2,233,000	1	$0
Mount Airy	No data available				
Myersville	2	$474	$187,000	0	$0
New Market	4	$1,599	$1,155,000	0	$0
Rosemont	No data available				
Thurmont	9	$9,780	$1,847,600	2	$7,856
Walkersville	26	$14,272	$7,382,000	1	$0
Woodsboro	1	$412	$350,000	0	$0
Unincorporated County	388	$452,213	$96,887,000	149	$1,313,542
Total	**624**	**$641,539**	**$156,999,000**	197	**$1,487,478**

Flood insurance is available to anyone in the County, including structures outside of the mapped SFHA, provided they are located in an NFIP-participating community.In some cases, therefore, the number of policies includes policies for structures that are outside the mapped SFHA.

Community Rating System (CRS)

Communities that regulate development in floodplains are able to participate in the NFIP. In return, the NFIP makes federally-backed flood insurance policies available for properties in the community. The Community Rating System (CRS) was implemented in 1990 as a program for recognizing and encouraging community floodplain management activities that exceed the minimum NFIP standards. There are ten CRS classes: class 1 requires the most credit points and gives the largest flood insurance premium reduction; class 10 receives no premium reduction. These discounts are applied per each CRS community and apply to all flood insurance policyholders.

The City of Frederick entered the CRS in October 2012 and participates as a “Class 7” community. This allows city residents in the SFHA to receive a 15 percent discount on their flood insurance premiums for policies purchased under the NFIP. Residents in non-SFHA areas receive a 5 percent discount on their policies.

Repetitive Loss Areas

A repetitive loss property is one for which 2 flood insurance claim payments of at least $1,000 have been paid by the NFIP in any 10 year period since 1978 (e.g., 2 claims during the periods 1978–1987, 1979–1988, etc.). These properties are important to the NFIP because they cost $200 million per year in flood insurance claim payments nationwide. Repetitive loss properties represent only 1 percent of all flood insurance policies; yet, historically, they account for nearly one third of the claim payments (over $4.5 billion to date). Mitigation of the flood risk to these repetitive loss properties will reduce overall costs to the NFIP as well as to individual homeowners.

There have been 57 repetitive flood losses in Frederick County from 25 properties. Of these losses, 55 are located in the unincorporated areas of the County and 2 are located in the City of Frederick. Table 3.23 summarizes the number of repetitive losses, the date of the last Community Assisted Visit (CAV), number of claims in areas located outside of the SFHA, total population, the number of Letters of Map Change (LOMCs) in the County and the type of properties. Fifteen of the 25 properties are no longer considered repetitive loss properties because they have been mitigated by the removal of the structure. Before the next plan update, Frederick County will work with the state and FEMA Region III to review and reconcile all sources of repetitive loss data.

Table 3.23a Repetitive Losses by Community

Community Name	# of Rep Losses	CAV Date	No of Claims in B/C/X Zones	Total Area Population	LOMCS
Frederick County	55	05/06/2010	12	233,439	267
Brunswick, City of	0	11/20/2013	0	6,167	12
Burkittsville, Town of	0	N/A	0	214	0
Emmitsburg, Town of	0	06/22/2011	0	2,900	8
Frederick, City of	2	12/07/2010	2	59,220	114
Middletown, Town of	0	11/20/2013	0	4,198	2
Mount Airy, Town of	0	UNK	0	9,288	UNK
Myersville, Town of	0	11/21/2013	0	1,530	0
New Market, Town of	0	N/A	0	427	0
Thurmont, Town of	0	12/11/2013	0	4,500	6
Walkersville, Town of	0	11/21/2013	0	5,583	15
Woodsboro, Town of	0	12/07/2012	0	506	4
Total	57		14	318,684	428

Table 3.23b Repetitive Losses by Property Type

Property Type	Number of Repetitive Loss Properties
COMMERCIAL	
Frederick	4
Point of Rocks	1
Commercial Total	5
RESIDENTIAL	
Frederick	2
Point of Rocks	1
Thurmont	2
Residential Total	5
MITIGATED	
Frederick	1
Point of Rocks	14
Mitigated Total	15
Grand Total	25

Mitigation Measures

Flash floods have been and will continue to be a significant threat to the economic and social well-being of the more developed areas of Frederick County, such as the City of Frederick and Mount Airy. In particular, the towns that have more population and economic assets are vulnerable to flood damages. Most flash flood events result in direct damage to structures and infrastructure in developed areas. The location and occurrence of flash floods is difficult to predict and is dependent on local conditions of terrain, land use, and percent of impervious cover. As a result, actions should focus on corrective measures for drainage in all future development plans in these areas.

Frederick County and the City of Frederick have completed flood mitigation projects in recent years. These projects are discussed below.

Point of Rocks Mitigation Project: Using federal, state, and local funding, Frederick County made purchase offers to the owners of properties in Point of Rocks that had sustained complete first floor

and partial second floor flooding 3 times in 6 years. The offers were based on the average of 2 appraisals. The Point of Rocks Flood Mitigation Project benefited the community by removing 14 repetitive loss properties from harm's way and protecting 75 people. The project permanently eliminated the risk of loss of life, injury, and property damage associated with flooding of these residences. In addition, the project saves approximately $350,000 in physical damages and $100,000 in response services for each future flood event. Additional project benefits include creation of public recreation space and additional parking areas.

Carroll Creek Mitigation Project: After Carroll Creek flooded much of the historic downtown business district in 1976, the City of Frederick invested in a $60 million, 10-year flood control project. Carroll Creek was channelized, and 4 underground concrete conduits, each wider than a city bus, were built to accommodate the 1 percent annual chance flood. As a result, FEMA no longer considers hundreds of valuable downtown properties to be in a mapped floodplain, saving businesses and residents millions in flood insurance.

The second phase of park improvements includes new and widened multi-use paths, landscape planters, lighting, water features, and crosswalk improvements. The work will occur primarily between Bentz and South Market Street and between the Delaplaine Arts Center and East Patrick Street; as of October 2015, the work is complete between Bentz Street and South Market Street and continues between East Street and East Patrick Street. More than $100 million in new and renovated private construction is planned along the new park/path sections, which will eventually result in hundreds of new jobs and increased state and local tax revenues.

One additional repetitive loss structure located on Canal Road was mitigated.

Dam and Levee Failure

The priority hazard ranking process determined dam and levee failure should remain a low priority hazard in Frederick County. There is no record of damages from dam and levee failure in Frederick County, nor any recorded incidents of dam and levee failure in the County. There are 21 dams in Frederick County. Of those, 13 present a low hazard level and 4 present a high hazard level. All of the high hazard dams are considered in excellent or good general condition. In addition, one privately owned dam presents a significant hazard level and 3 dams have not been ranked.[48] Table 3.24 outlines the rankings for each of the hazard priority criteria related to dam and levee failure.

Six critical facilities are located in the potential dam inundation areas for 3 dams in the County. These facilities are shown in Appendix A, Table A.1. The September 2014 Monocacy Watershed Discovery Report indicates a need for coordination with the City regarding a levee located along Carroll Creek (Carroll Parkway Levee). Coordination would ensure community understanding of the mapping requirements for levees and would prepare residents for the possibility that the levee will not be shown as providing protection from the base flood.

Table 3.24 Dam and Levee Failure Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Unlikely No documented occurrence with annual probability <0.01	**Negligible** 1 to 10% of people or property	**Small** 5% to 25% of community impacted	**No Notice** < 24 hours	**Low**	**Low**

Wildfire Hazards

Wildfires and Urban Interface Fires

The priority hazard ranking process determined wildfire to be a medium priority hazard in Frederick County. Table 3.25 outlines the hazard rankings for each of the hazard priority criteria related to wildfire.

Table 3.25 Wildfire Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Highly Likely Common events with annual probability >1	**Negligible** 1 to 10% of people or property	**Small** 5% to 25% of community impacted	**No Notice** < 24 hours	**Medium**	**Medium**

Background

Future wildfires and urban interface fires could cause substantial loss of property along with direct and indirect economic effects for residents and community businesses. The best available data suggests that approximately 32 percent of Frederick County lies in forested areas.[49] As indicated previously, in recent years, Frederick County has experienced an increase in population in urban and rural areas. The Fire Zones map (Appendix C, Figure C.8) prepared by the Maryland Department of Natural Resources divides the County into distinct zones that identify the fire risk for that area. The risk is based on factors such as fuel type, slope, potential for ignition (human), and land value. Zone 6 is considered the area with the highest risk and Zone 1, the lowest risk. There are no Zone 1 designations in the County. Significant parts of the County including the City of Frederick, Walkersville, and southwest portions of the unincorporated areas of the County, lie in Zone 2. Zone 3 includes Brunswick, Burkittsville, Emmitsburg, Libertytown, Middletown, Mount Airy, New Market, Rosemont, Thurmont, Woodsboro, and unincorporated areas in the southeast part of the County; Zone 4 includes the Myersville area, and portions of the northwestern part of Frederick County make up Zone 5. The Zone 6 area carries the highest fire risk posing concern for future development and is located primarily in the northwest part of the county.

Loss Estimation

In assessing physical vulnerability, the most important factor is the extent to which structures sustain damage when they are exposed to fire and heat. Current standard loss estimation tables do not exist for wildfires. The local fire department and structural engineers should help estimate structure and content damage from wildfires. Using critical facilities data and the WUI spatial extent, 43 facilities are located in wildland interface areas, and 16 facilities are located in wildland intermix areas for a total of 59 facilities with increased wildfire vulnerability. Of these facilities, 16 are water/wastewater treatment plants, 12 are public schools and 10 are Fire/EMS facilities. The majority of the facilities are located in the unincorporated areas of the County, with 7 in Thurmont, 4 in Myersville, and 4 in the City of Frederick. Table A.1 in Appendix A includes the specific facilities and associated hazard vulnerabilities.

Building footprints were intersected with the WUI risk zones for interface and intermix. Eighteen percent of the structures in Frederick County are in interface wildfire risk zones and 14 percent are in intermix zones. Approximately 21 of the total county exposure is vulnerable to wildfires. Table 3.26 summarizes the number of structures within interface and intermix and the associated vulnerability.

Table 3.26 Number of Building Footprints Within Wildfire Risk

Municipality	Total # Building Footprints	Interface	Intermix	Total Market Value Vulnerability	Total Market Value Exposure
Brunswick	3,755	5	0	$939,800	$354,310,200
Burkittsville	197	184	0	$12,907,820	$13,519,180
Emmitsburg	1,351	646	0	$87,770,190	$200,870,350
Frederick City	28,247	3,848	0	$1,174,001,170	$10,940,436,934
Middletown	2,326	340	0	$56,810,990	$359,034,590
Mount Airy	1,994	0	20	$2,464,980	$316,415,110
Myersville	898	872		$105,614,590	$105,909,990
New Market	745	0	0	$0	$93,321,690
Rosemont	306	0	8	$981,160	$28,854,860
Thurmont	4,351	3,720	140	$389,411,950	$432,713,010
Unincorporated County	118,136	20,482	23,184	$4,280,496,974	$15,287,458,274
Walkersville	3,515	0	21	$1,466,980	$523,532,910
Woodsboro	839	0	106	$14,394,440	$90,064,720
Total	**166,660**	**30,097**	**23,479**	**$6,127,261,044**	**$28,746,441,818**

Most wildfire-related deaths occur as a result of fire suppression activities; however, if roads are damaged or there is insufficient warning, other injuries and deaths could occur. Since death or injury statistics curves for wildfire are not available, they are estimated based on past wildfire events. More information about specific properties in or near wooded areas as well as total damage values would support determination of the relative vulnerability, as would an assessment of the vegetation types in determining specific risk factors.

There are two sources of wildfire event data, but it is not possible to reconcile the two data sets to ensure double-counting does not occur. Based on the two data sets, there have been at least 382 wildfire events recorded in the County since 1998, resulting in an expected annual number of events of 21.2. Based on historic damages of $18,882 from NCDC and DNR, Frederick County on average may experience $1,451 in annual wildfire-related costs and damages.

Future Trends

If more development is planned in the more rural or forested areas, the occurrence of human-caused fires and the number of people and property at risk due to wildfires and WUI fires will likely increase. Particular attention should be paid while planning for development in Zones 4 and 5.

Mitigation Measures

As people move to the more rural and forested areas of the County, the increased development creates danger for both forests and the population there. Mitigation options for WUI fires need to address not only the management of fuels, but also the potential for a growing population in wildfire threat areas. These measures may also define the necessary interface between private property needs and natural resource needs, public education, fire breaks, and maintenance of fire roads. Hazardous fuels reduction, defensible space, and ignition-resistant construction materials and techniques are other options.

Geological Hazards

Earthquakes

The priority hazard ranking process determined earthquakes to be a medium-low priority hazard in Frederick County. The hazard priority for earthquakes was elevated from low in 2009 to medium-low for the 2015 plan update. Earthquakes are a low probability, high consequence event. There is no record of damages from earthquakes in Frederick County, nor are there any recorded events originating from within the County. Table 3.27 outlines the hazard rankings for each of the hazard priority criteria related to earthquakes.

Table 3.27 Earthquake Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Unlikely No documented occurrence with annual probability <0.01	**Limited** 10 to 25% of people or property	**Small** 5 to 25% of community impacted	**No Notice** < 24 hours	**Low**	**Medium-Low**

Landslides

The priority hazard ranking process determined landslide to be a medium-low priority hazard in Frederick County. The hazard priority for landslides was elevated from low in 2009 to medium-low for the 2015 plan update. There is no record of damages from landslides within Frederick County nor any recorded occurrences of landslides in the County. Table 3.28 outlines the hazard rankings for each of the hazard priority criteria related to landslides.

Table 3.28 Landslide Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Unlikely No documented occurrence with annual probability <0.01	**Limited** 10 to 25% of people or property	**Small** 5 to 25% of community impacted	**No Notice** < 24 hours	**Low**	**Medium-Low**

Using critical facilities data and the USGS landslide susceptibility and incidence spatial extent (Appendix C, Figure C.4), 173 facilities are located in high susceptibility and incidence areas. Of these facilities, 40 are water/wastewater treatment facilities, 37 are public schools, and 23 public facilities. The majority of the facilities (67) are located in the unincorporated areas of the county, with 50 in the City of Frederick. Table A.1 in Appendix A includes the specific facilities and associated hazard vulnerabilities.

Building footprints were intersected with the USGS landslide susceptibility and incidence spatial extent. Table 3.29 summarizes the number of structures in the high susceptibility and incidence zones. More than 50 percent (54 percent) of building footprints and 59 percent of building value vulnerability are located in areas of high susceptibility and incidence for landslides.

Table 3.29 Number of Building Footprints Within Landslide Risk

Municipality	Total # Building Footprints	High Susceptibility and Incidence	Total Market Value Vulnerability	Total Market Value Exposure
Brunswick	3,755	3,755	$354,310,200	$354,310,200
Burkittsville	197	197	$13,519,180	$13,519,180
Emmitsburg	1,351	1,073	$175,250,770	$200,870,350
Frederick City	28,247	21,782	$9,735,460,264	$10,940,436,934
Middletown	2,326	2,326	$359,034,590	$359,034,590
Mount Airy	1,994	0	$0	$316,415,110
Myersville	898	898	$105,909,990	$105,909,990
New Market	745	0	$0	$93,321,690
Rosemont	306	306	$28,854,860	$28,854,860
Thurmont	4,351	4,351	$432,713,010	$432,713,010
Unincorporated County	118,136	53,225	$5,612,475,540	$15,287,458,274
Walkersville	3,515	816	$195,547,140	$523,532,910
Woodsboro	839	707	$72,567,020	$90,064,720
Grand Total	**166,660**	**89,436**	**$17,085,642,564**	**$28,746,441,818**

Karst/Land Subsidence

The priority hazard ranking process determined karst/land subsidence to be a medium-high priority hazard in Frederick County. The hazard priority for karst/land subsidence decreased from high in 2009 to medium-high for the 2015 plan update. Table 3.30 outlines the hazard rankings for each of the hazard priority criteria related to karst/land subsidence.

Table 3.30 Karst/Land Subsidence Hazard Priority

Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Highly Likely Common events with annual probability >1	**Limited** 10 to 25% of people or property	**Isolated** < 5% of community impacted	**No Notice** < 24 hours	**High**	**Medium-High**

Background

Where land subsidence or sinkholes exist, runoff, spills, or pesticides and fertilizers from lawns and farms can leak through the many spaces in the rock, unfiltered by the soil, enter the groundwater system, and leak into water resources. Since thousands of residents in this region get their water from private home wells, these areas would be especially susceptible to immediate pollution. The Frederick Quarry is another major cause of sinkholes in the area; quarry owners are required to repair sinkholes within the established Zone of Influence.

The Maryland State Highway Administration conducted a study of the extent of sinkholes near major transportation routes in Frederick County. Fifteen sinkholes more than 6 feet deep were located throughout the county. Of these, 6 were near/in the City of Frederick, 2 were near U.S. Route 15, and 3 were near Maryland Route 194. Two sinkholes more than 10 feet deep were found south of the City of Frederick, one near Interstate 70 and the other near Interstate 270.

Loss Estimation

Based on critical facilities data and the USGS engineering aspects of karst spatial extent (Appendix C, Figure C.5), 98 facilities are located in areas of karst. Of these facilities, 51 facilities are located in the City of Frederick and the remaining 47 facilities are in the unincorporated areas of the county. Nineteen of the facilities are classified as public facilities, 18 as schools, and 17 as water/wastewater treatment facilities. Table A.1 in Appendix A includes the specific facilities and associated hazard vulnerabilities.

Building footprints were intersected with the USGS engineering aspects of karst spatial extent. Table 3.31 summarizes the number of structures and the associated market value vulnerability for areas in karst topography. The City of Frederick and the unincorporated areas of the county are vulnerable to sinkholes due to karst topography. Nearly half (48.4 percent) of the structures located in the City of Frederick are in karst geology and have an associated vulnerability of $5.7 billion (52.8 percent of the city's total exposure).

Table 3.31 Number of Building Footprints Within Karst Risk

Municipality	Total # Building Footprints	Karst Geology	Total Market Value Vulnerability	Total Market Value Exposure
Brunswick	3,755	0	$0	$354,310,200
Burkittsville	197	0	$0	$13,519,180
Emmitsburg	1,351	0	$0	$200,870,350
Frederick City	28,247	13,680	$5,772,553,094	$10,940,436,934
Middletown	2,326	0	$0	$359,034,590
Mount Airy	1,994	0	$0	$316,415,110
Myersville	898	0	$0	$105,909,990
New Market	745	0	$0	$93,321,690
Rosemont	306	0	$0	$28,854,860
Thurmont	4,351	0	$0	$432,713,010
Unincorporated County	118,136	20,779	$3,767,159,950	$15,287,458,274
Walkersville	3,515	0*	$0*	$523,532,910
Woodsboro	839	0*	$0*	$90,064,720
Grand Total	**166,660**	**34,459**	**$9,539,713,044**	**$28,746,441,818**

**Walkersville and Woodsboro are located in rock types associated with karst activity (limestone and dolomite). It should be noted that USGS mapping underrepresents the vulnerability of these areas in Frederick County.*

There have been over 300 karst/land subsidence events in the County since 2004, resulting in an expected annual number of events of 25. Based on historic damages from Frederick County DPW of $210,086, Frederick County may experience $17,507 annually in sinkhole related costs including road clearing and damages.

Future Trends

Increased population in the Frederick County region will increase demands on groundwater supplies; this will cause more land subsidence in areas already experiencing sinkholes, as well as new subsidence in other areas. In the past, major subsidence areas have been in agricultural settings where groundwater has been pumped for irrigation.

In the future, increasing population may result in problems in urban areas where damage from subsidence can be significant. Numerous sinkholes have occurred in close proximity to Interstate 70, resulting in closures of the interstate and other major arterial roads.

Mitigation Measures

Several county and local governments in other states have legislated special water-management practices for industrial or commercial sites located in karst areas that require:

- Refraining from dumping anything onto a parking lot, storm drain, or down a sinkhole
- Diverting water runoff away from sinkholes
- Remediating sinkholes that receive runoff as soon as possible
- Maintaining vegetation on steep slopes to keep soil in place
- Identifying the best practices for dispersed storm water management in karst areas
- Working with the local health department to select the best septic system for each site and contacting local health officials if there is a reason to believe the system is malfunctioning

Under a 1991 Amendment to Maryland's Surface Mining Law, the MDE is required to establish and define Zones of Influence (ZOI) around limestone and marble quarries in Baltimore, Carroll, Frederick, and Washington Counties. A quarry's ZOI is based on local topography, watersheds, and geologic and hydrologic factors. When establishing ZOIs, MDE conducts field investigations and evaluates any available information (e.g., groundwater studies and well monitoring data).

Overall Vulnerability Assessment Conclusions

Loss Estimates

As described in the hazard-specific estimated loss sections, the County has experienced at least 1,526 hazard events since 1950, as recorded by NCDC, Frederick County DPW, AMS, and MD DNR. Table 3.32 summarizes the estimated annualized damages.

Table 3.32 Estimated Loss Estimates by Hazard Type

Hazards Type	Annualized Events	Annualized Damages
Atmospheric Hazards		
Extreme Heat	1.48	$0
Extreme Wind	2.09	$36,287
Thunderstorm	5.17	$59,226
Hailstorms	0.97	$375
Lightning	1	$50,609
Severe Winter Weather	6.48	$526,027
Tornado	0.53	$78,577
Tropical Storm/Hurricane	0.16	$17,077
Hydrological Hazards		
Drought	0.52	$1,571,275
Flash Floods and Flooding	5.91	$1,432,112
Dam Failure	0	$0
Wildfire Hazards		
Wildfire/Wildland Urban Interface	21.2	$1,452

Hazards Type	Annualized Events	Annualized Damages
Geological Hazards		
Earthquake	0	$0
Landslide	0	$0
Karst/Land Subsidence	25	$17,507
	Total	**$3,790,524**

Critical Facilities

As described in each hazard-specific section, hazards with defined spatial extents were intersected with critical facility locations. Table 3.33 provides a summary by facility type of locations in the hazard zones. Location details, shown by jurisdiction, are provided in Appendix A, Table A.1. Facilities located in 1 or multiple hazard zones have been evaluated and used as the starting point for new mitigation actions for the plan update.

Fifteen critical facilities were located in 3 hazard zones. One facility, the Thurmont Regional Library, is located in the intermix wildfire zone, in an area of high landslide vulnerability, and in the Hunting Creek dam inundation area. The remaining facilities are located in the unincorporated area of the County. These include:

- Wolfsville Volunteer Fire Company
- Sabillasville Post Office
- Myersville Highway Fleet Maintenance
- Sabillasville Elementary School
- Wolfsville Elementary School
- Tower Road Radio Tower
- 6 Wastewater Treatment Plants
- 2 Water Treatment Plants

Table 3.33 Critical Facilities Located in Hazard Zones

Facility Type	Flood Zone	Wildland Urban Interface/Intermix	Karst Topography	Landslide Susceptibility	Dam Inundation
Fire/EMS	1 (within Floodway)	7/3	8	21	1
Law Enforcement	0	0	6	3	0
Library	0	0/1	1	4	1
Nursing and Care Facility	0	2/1	14	17	0
Post Office	0	7/0	7	16	0
Public Facility	2	6/2	21	28	0
Public School	1	10/2	18	38	0
Radio Tower	1	0/2	4	6	0
Transportation	2	0/0	3	2	0
WTP/WWTP	8	11/5	17	42	4
Total	**15**	**43 interface/ 16 intermix**	**98**	**177**	**6**

Hazard Prioritization

As discussed at the beginning of this chapter, each hazard was re-evaluated for the 2015 plan update based on the hazard priority criteria. This plan further categorizes the hazards as high, medium-high, medium, medium-low, and low. As shown in Table 3.34, severe winter weather and flood are the highest ranked hazards in the County, followed by extreme wind, and karst/land subsidence with a ranking of medium-high priority.

Previous plan hazard rankings changed based on the priority ranking criteria thresholds (Table 3.34). The scores for each criteria were reviewed across hazards in an effort to standardize the priority levels. Extreme wind, thunderstorm, tornado, and karst were previously ranked (2009) as high and as part of the update have decreased in priority.

Table 3.34 Hazard Priority Level Comparison

Hazards Type	Probability/ History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Committee Ranking	2015 Priority Level
Atmospheric Hazards						
Extreme Heat	Highly Likely	Negligible	Large	Extended	Low	Medium
Thunderstorm	Highly Likely	Negligible	Small	Minimal	High	Medium
Extreme Wind	Highly Likely	Limited	Small	Minimal	High	Medium-High
Hailstorms	Somewhat Likely	Negligible	Isolated	Minimal	Medium	Medium-Low
Lightning	Highly Likely	Negligible	Isolated	Minimal	Medium	Medium
Severe Winter Weather	Highly Likely	Critical	Large	Limited	High	High
Tornado	Likely	Negligible	Isolated	No Notice	High	Medium
Tropical Storm/ Hurricane	Somewhat Likely	Limited	Medium	Extended	Medium	Medium
Hydrological Hazards						
Drought	Likely	Negligible	Medium	Extended	Medium	Medium
Flash Floods and Flooding	Highly Likely	Critical	Small	Minimal	High	High
Dam and Levee Failure	Unlikely	Negligible	Small	No Notice	Low	Low
Wildfire Hazards						
Wildfire/WUI	Highly Likely	Negligible	Small	No Notice	Medium	Medium
Geological Hazards						
Earthquake	Unlikely	Limited	Small	No Notice	Low	Medium-Low
Landslide	Unlikely	Limited	Small	No Notice	Low	Medium-Low
Karst/Land Subsidence	Highly Likely	Limited	Isolated	No Notice	High	Medium-High

Development Trends Analysis

Based on 2015 data from the Frederick County Planning Department, the County's land area totals 626.6 square miles or 401,032 acres. Of this, agricultural uses make up 59.2 percent, residential uses make up 20.9 percent (with an additional 2.0 percent of planned unit development),

commercial and industrial uses make up 2.0 percent, institutional uses make up 0.3 percent, and mixed use development makes up 0.3 percent. The predominant land use is agriculture. According to the 2010 Comprehensive Plan, the Walkersville Region contains the highest percentage of agricultural use, with 88 percent of the land area devoted to agriculture. The Frederick Region, which is dominated by the City of Frederick, has the lowest percentage of agricultural land use at 40.5 percent.

As development increases, risk and exposure to hazards increase. In order to mitigate the effects of hazards, future land use planning has to consider the approximate locations and impacts of various hazard events by siting development in lower-risk areas of the community.

The County recognizes the impacts that haphazard development could have on the natural environment or significant historic resources and views this as a priority. Growth is conducted in a manner that protects the County's sensitive resources, including: streams and their buffers, SFHAs, habitats of threatened and endangered species, steep slopes, the Monocacy Scenic River, areas of prime agricultural soils outside of community growth areas, groundwater resources (specifically well-head protection areas), wetlands, limestone conglomerate/carbonate rock areas, and historic and archaeological resources.

According to the Frederick County Planning Department, no development has occurred in the floodplain in the past 5 years.

Capability Analysis

Frederick County has a number of resources it can access to implement hazard mitigation initiatives. These resources include both private and public assets at the local, state, and federal levels.

A detailed Hazard Mitigation Capabilities Assessment Questionnaire was prepared and distributed to the County and municipalities for response. The questionnaire was designed to assess the community's ability to reduce future losses from hazards like floods and winter storms through its various policies and programs. The intent of the capability assessment was to provide an inventory of existing policies, programs, practices, and operational responsibilities that have or may have a major role in supporting the community's mitigation program. The results of the questionnaire are integral to the development of a mitigation strategy, the backbone of the local hazard mitigation plan 2015 revision. The questions presented in the questionnaire covered several agencies in the jurisdictions, particularly the County. These agencies included the Planning and Permitting Division, Division of Public Works, and Division of Public Safety. Table 3.35 summarizes the capabilities of the local county and municipalities that will facilitate implementation of the mitigation strategy.

Two important capabilities are the floodplain management ordinance and building code administration and enforcement. Through the administration of floodplain ordinances, each local government can ensure that all new construction or substantial improvements to existing structures located in the SFHA are built with first-floor elevations above the Base Flood Elevation (BFE).

Building codes are important in mitigation; codes developed regionally consider the hazards present in a region of the country. Consequently, structures that are built to applicable codes are inherently resistant to localized strong winds, floods, and earthquakes.

Each municipality has a separate floodplain management ordinance and storm water management ordinance. The County administers the building codes for all but the City of Frederick. Each municipality has either a stand-alone storm water regulation (City of Frederick) or has adopted the County's storm water ordinance. The Soil Conservation District approves erosion and sediment control plans for land-disturbing activities. The county provides inspection and enforcement

functions except in the City of Frederick, which does its own inspection and enforcement. The municipalities use the services of the Frederick County Department of Permits and Inspection for building inspections. The County has an inventory of historic structures, public and private parks, and open space for unincorporated areas of the County and municipalities.

Table 3.35 Mitigation Capability Analysis Compilation

	Community Name												
	Frederick County	Brunswick	Burkittsville	Emmitsburg	Frederick City	Middletown	Mount Airy	Myersville	New Market	Rosemont	Thurmont	Walkersville	Woodsboro
Comprehensive Plan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
With Hazard Mitigation Element	Yes	No	No	No	No	No	No	No	No	No	No	No	No
Subdivision Regulations	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Zoning Ordinance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stormwater Management Program+	Yes	Yes+	Yes+	Yes+	Yes	Yes	Yes	Yes+	Yes	Yes+	Yes+	Yes	Yes+
Building Code that Addresses Natural Hazards	Yes		No	Yes	Yes	Yes	Yes	No	No	Yes	No	No	No
Extreme Heat	-		NA	No	No	-	No	-	NA	NA	NA	NA	-
Extreme Wind	-		NA	No	No	-	No	-	NA	NA	NA	NA	-
Severe Winter Storm	-		NA	Yes	No	-	No	-	NA	NA	NA	NA	-
Thunderstorms/ Lightning	-		NA	No	No	-	No	-	NA	NA	NA	NA	-
Tornadoes	-		NA	Yes	No	-	No	-	NA	NA	NA	NA	-
Tropical Storm/Hurricane	-		NA	No	No	-	No	-	NA	NA	NA	NA	-
Flooding	-		NA	Yes	Yes	-	Yes	-	NA	NA	NA	NA	-
Wildfires/ Wildland-Urban Interface Fires	-		NA	No	No	-	No	-	NA	NA	NA	NA	-
Earthquakes	-		NA	No	No	-	No	-	NA	NA	NA	NA	-

	Community Name												
	Frederick County	Brunswick	Burkittsville	Emmitsburg	Frederick City	Middletown	Mount Airy	Myersville	New Market	Rosemont	Thurmont	Walkersville	Woodsboro
Land Subsidence (Includes Landslides and Sinkholes)	-		NA	No	No	-	No	-	NA	NA	NA	NA	-
Designated Building Official	Yes	No	No	Yes	Yes	No	No	No	No	No	Yes	No	NA
Regular Inspections	Yes	NA	NA	No	Yes	NA	NA	NA	NA	No	No	NA	NA
Mitigation projects to improve local plans and regulations	Yes	No	No	No	Yes	Yes	Yes	No	No	NA	Yes	No	No
Structure and infrastructure mitigation projects	Yes	No	No	No	Yes	Yes	Yes	Yes	No	No	Yes	No	No
Private Buildings or Property Protection	No	NA	NA	NA	Yes	No	No	No	No	NA	Yes	NA	NA
Public Buildings or Property Protection	Yes	NA	NA	NA	Yes	Yes	Yes	No	No	NA	Yes	NA	NA
Critical Facilities Protection	No	NA	NA	NA	No	Yes	Yes	Yes	No	NA	Yes	NA	NA
Natural systems protection	Yes	No	No	No	Yes	Yes	Yes	Yes	No	No	No	No	No
Natural or cultural resources inventory	Yes	No	Yes	No	Yes	No	Yes	No	No	No	No	No	No
Erosion or sediment control mitigation projects	-	Yes	No	No	Yes	Yes	Yes	No	No	No	No	No	No
Floodplain Management Ordinance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	No	Yes	Yes	No

	Community Name												
	Frederick County	**Brunswick**	**Burkittsville**	**Emmitsburg**	**Frederick City**	**Middletown**	**Mount Airy**	**Myersville**	**New Market**	**Rosemont**	**Thurmont**	**Walkersville**	**Woodsboro**
Floodplain Administrator	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	-
Participates in NFIP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Joined	1978	1977	2010	1980	1978	1981	2014	2008	2007	2010	1979	1974	1978
Effective FIRM Date	9/19/2007												
Additional Freeboard Requirements (ft.)	1 ft.	1 ft.	NA	1 ft.	1 ft.	None	None	None		-	1 ft.	None	-
NFIP Manager	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		-	Yes	No	-
Restrictive Ordinances	*	**	NA	**	**	15-06-01	Floodplain ordinance	Floodplain ordinance		-	**	***	-
Participates in CRS	No	No	No	No	Yes	No	No	No	No	No	No	No	No
Emergency Operations Plan	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
Warning Sirens	No	Yes	Church bells	Yes	No	Yes	No	Yes	Yes (at fire station)	No	Yes (at fire station)	No	No
With NOAA Weather Radio	Yes	No	No	Yes	NA	Yes	No	Yes	-	No	No	NA	-
Public Information Program	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No

	Community Name												
	Frederick County	Brunswick	Burkittsville	Emmitsburg	Frederick City	Middletown	Mount Airy	Myersville	New Market	Rosemont	Thurmont	Walkersville	Woodsboro
Additional Capabilities (please specify)	None	No	No	No	Additional freeboard and more restrictive ordinance language	No	Partner with Frederick and Carroll County for emergency notification for residents	Alert Myersville, Channel 9 access, Town website	None	No	EAP for Hunting Creek Lake	None	None

*Setback, limited fill, historic flooding, flooding soils, variance to build in floodplain
**Setback, limited fill
***Zoning prohibits development in floodplain
+Storm Water Management program administered at the County level

Plan Assessment

A review of enabling statutes, ordinances, planning documents, and building codes revealed that some aspects of the municipal regulations strongly supported mitigation capabilities. Tables 3.36 and Table 3.37 identify County- and municipal-level plans and opportunities to enhance the County's and municipalities' mitigation efforts if specific sections are strengthened or revised. Though many of the plans mentioned below are somewhat dated, they are the most current plans as of October 2015. For the municipal plans, the responsible party would be the affected municipality.

Table 3.36 County-Level Plan Assessment

Plan Name	Description	Integration Options
2010 Frederick County Comprehensive Plan	This plan updates the 1998 Countywide Comprehensive Plan, which was a policy document that provided guidance for subsequent updates to the County's 8 region plans. The Plan initiates a new planning process for the County and includes the following elements: agricultural and rural communities, green infrastructure, economy, water resources, transportation, and growth management.	A hazard mitigation element is included in the 2010 Comprehensive Plan, Chapter 3, pages 3 to 11. It is only a brief description of hazards, which includes a table listing the hazards and their priority. There is one action item regarding sinkholes. In the next Comprehensive Plan, include all "Plans and Ordinances" action items from the Hazard Mitigation Plan. Also, consider including a chapter that specifically addresses current and future development in hazard prone areas.
2012 Frederick County Land Preservation, Parks and Recreation Plan	The Land Preservation, Parks and Recreation Plan (LPRP) provides the necessary framework from which to develop an integrated and coordinated approach to 3 primary elements, parks and recreation, agricultural land preservation, and natural resource conservation. The State requires the plan to be updated every 6 years in order for the County to remain eligible for Program Open Space (POS) funding. All land acquisition and park development funded through POS must be consistent with the approved State and County LPRP.	The Plan includes a water body buffer ordinance floodplain regulations on pages 51 and 52, which address development in flood-prone areas. Consider adding element to address wildfires.
1990 Monocacy Scenic River Study and Management Plan	The River Management Plan was prepared by the Maryland Department of Natural Resources to provide a blueprint for restoring the water quality of the Monocacy River and managing this riparian resource wisely. The Plan includes detailed information on the river's ecology, geology, and its exploration and settlement history, plus cultural and other historical elements. Water quality and land uses in the river's watershed are also a main focus of the management plan.	Maryland Department of Natural Resources is responsible for this plan. If it were to be updated, the County could advocate to include language relevant to hazard mitigation.

Plan Name	Description	Integration Options
2007 Frederick County Historic Preservation Plan	The first County Historic Preservation Plan was adopted in 1997 and updated in 2007. It is a broad statement of historic preservation goals, objectives, and strategies and a description of the existing resources for preservation. The 1997 Plan provided the foundation for establishing the County's Historic Preservation Commission and the Historic Preservation Ordinance.	In the next Plan, include a goal to mitigate the impact of hazards on historic sites and resources. Also consider adding a section that discusses historical sites in hazard-prone areas, the potential impacts of different hazards, and potential mitigation options.
2004 Catoctin Mountain National Scenic Byway Corridor Management Plan	The Catoctin Mountain National Scenic Byway follows U.S. Route 15 from the Pennsylvania border to the Potomac River. In 2003, the corridor was designated a State Scenic Byway and a National Scenic Byway. The Management Plan provides a description of the intrinsic qualities (historic, recreational, natural, cultural etc.) of the corridor as the basis for understanding the important resources along the corridor and details strategies for conserving its intrinsic qualities and managing improvements and changes. The Catoctin Mountain Scenic Byway became part of The Journey Through Hallowed Ground National Heritage Area in May 2008.	If a plan update is deemed necessary, include language that addresses natural hazard risk and mitigation.
2008 Frederick County Agricultural Strategic Plan	This Plan was prepared through the County's Office of Economic Development (OED) as an update of an Agricultural Market Analysis and Strategic Plan prepared in 2001. The 2008 Strategic Plan conducted an assessment of the agricultural industry and sectors in the County including an analysis of the strengths, weaknesses, opportunities, and threats of the agricultural economy. The Plan includes recommendations under 3 areas: market developments, training and education, and regulatory support for agriculture.	In the next Plan, include strategies for educating the agricultural community on the impacts of hazards on agricultural resources and strategies for risk reduction.
2007 Transportation Development Plan (TDP)	Assesses current services and recommends transit improvements and expansion for the following 5-10 year period. The current TDP was adopted in 2007. TransIT Services also works with an appointed committee, the Transportation Services Advisory Council (TSAC), to identify transportation trends and issues and increase awareness of transportation alternatives.	As part of the development of the next Plan, meet with the Plan developers to discuss the impacts of hazards on the road system and identify viable road improvement projects that would be eligible for mitigation funding.

Plan Name	Description	Integration Options
2004 Lake Linganore Source Water Protection Plan	This plan addresses water quality and quantity issues of Lake Linganore and Linganore Creek, which are used as a drinking water source by the City of Frederick and the County. The plan looks at the portion of the Linganore Creek watershed that drains into Lake Linganore and addresses issues related to agriculture, land development, infrastructure and maintenance, homeowner impacts, and education/outreach. In 2006 an Action Plan for the Linganore Source Water Protection Plan was prepared that identifies specific action items.	This Plan is not controlled by the County. If the Plan is updated, the County should meet with the Plan developers to discuss relevant hazards.
2014 Frederick County Water and Sewerage Plan	The purpose of the Water and Sewerage Plan is to provide an overview of the goals, policies, and procedures for implementing water and sewerage plans. The Plan includes descriptions of both County and municipal water and sewerage systems including assessments of current demands/use and available capacities. The mapping component includes the various water/sewerage plan classifications, which identifies existing service areas and planned service areas. This Plan is required by the State and is updated every 3 years.	In the next Plan, include strategies for mitigating the risk of flooding on the sewer system, particularly drainage improvements intended to handle heavy downpours during storms.

Table 3.37 Municipal-Level Plan Assessment

Plan Name	Description	Integration Options
2010 Brunswick Master Plan	The 2010 Brunswick Master Plan is an update of all previous plans that have been adopted since 1967. The original Plan was designed to serve as a guide for the future of Brunswick, with recommendations for land use, transportation patterns, capital improvements, and public facilities. The Plan provides information about demographic profiles, the environment and sensitive areas, land use, transportation, water resources, municipal growth, and community facilities.	Consider including a section that specifically addresses current and future development in hazard-prone areas.

Plan Name	Description	Integration Options
2009 Emmitsburg Comprehensive Plan	The 2009 Comprehensive Plan sets forth policies governing growth, development, and conservation in Emmitsburg.	The Plan discusses the use of vegetated buffers along streams and in floodplains to mitigate flooding impacts. Consider including a section that specifically addresses current and future development in hazard-prone areas.
2013 The Golden Mile Small Area Plan (City of Frederick)	This plan is intended to encourage the redevelopment of the U.S. Route 40 Corridor through the use of incentives, public and private investment, and legislative policies that will provide additional tax base, economic revitalization, jobs, and business opportunities to the City.	The Plan discusses the use of Low Impact Development (LID) such as green roofs, permeable and porous pavements, and grass swales to mitigate the impacts of hazards such as flooding/stormwater runoff, erosion, and the urban heat island effect. In the next Plan, consider including a section that specifically addresses current and future development in hazard-prone areas.
2010 Frederick City Comprehensive Plan	This Plan is a guide for the location, character, and extent of proposed public and private development in the City of Frederick, Maryland. It also provides guidance on how the City's development regulations should be updated, enhanced, and streamlined to facilitate Plan implementation.	In the next Plan, consider adding a section that specifically addresses current and future development in hazard-prone areas.
2010 Middletown Comprehensive Plan	This Plan provides a framework to provide future decision-making concerning growth, development, and the provision of public services in Middletown.	In the next Plan, consider adding a section that specifically addresses current and future development in hazard-prone areas.
2014 Mount Airy Master Plan	The Master Plan guides land use decisions made by the Planning Commission and Town Council. The Plan addresses physical growth, is long range in scope, and is comprehensive. The Plan highlights the limiting impact that the town's water system capacity has had and will have on future growth. The town has explored a variety of mitigation options including bringing a new well online. The plan has a goal focused on preservation and protection of Mount Airy's environmental and cultural resources. The Plan also includes a section on floodplains and steep slopes.	Continue to address protection of groundwater resources.

Plan Name	Description	Integration Options
2005 New Market Master Plan	This Plan identifies community values as provided by residents and local leaders, and serves as a guide to local planning and elected officials when reviewing development proposals, zoning issues, and public works projects.	In the next Plan, consider a section that specifically addresses current and future development in hazard-prone areas.
2010 Thurmont Master Plan	This Plan identifies community values as expressed by citizens and elected officials and provides guidance for decision-making by town officials when reviewing development plans, rezoning requests, annexations, and planning for community facilities.	In the next Plan, consider a section that specifically addresses current and future development in hazard-prone areas.
2011 Walkersville Comprehensive Plan	This Plan is intended to maintain Walkersville's small town character, allow for future development to support limited growth, protect natural, historic, and scenic resources, and maintain a high quality of life for residents.	The Town of Walkersville adopted Frederick County's Forest Resource Ordinance (FRO). The FRO was adopted so that new development will occur in such a way that the conservation, protection, and planting of trees to produce forested areas would stabilize soil, reduce stormwater runoff, remove pollutants from the air, create buffers and protected environments for wildlife, mitigate heat islands, conserve and enhance the County's aesthetic appearance, and protect the public's health and safety. In the next Plan, consider adding a section that specifically addresses current and future development in hazard-prone areas.

CHAPTER 4 – GOALS AND OBJECTIVES

Introduction

This chapter presents a series of goals and objectives to help Frederick County and its municipalities identify and select mitigation actions to address its vulnerabilities, as discussed in Chapter 3. The selected mitigation actions will help the county avoid, prevent, or otherwise reduce damages from hazards.

While the Hazard Identification and Vulnerability Assessment chapters identified potential hazards and the areas and facilities in the County vulnerable to them, this chapter will identify broad ideas to address these vulnerabilities and reduce the risk from natural hazards. Chapter 5 will lay out a specific mitigation strategy by specifying mitigation action items, prioritizing these actions, identifying the responsible department for completion, completion of the action, and identifying potential funding sources.

Mitigation Goals and Objectives

In the HMPC and public meetings conducted on September 15, 2015, local government representatives discussed the findings of the vulnerability assessment and its implications for mitigation strategies. Committee members then had an opportunity to update the Plan's goals, objectives, and strategies. The committee decided to switch from a numbering scheme for the goals to using letters to identify the goals; this decision was made because the goals are not prioritized and the committee felt a numbering scheme implied ranking. In addition, two goals from the previous plan (#2 and #3) were collapsed into Goal B in this plan. The goals on the next page represent Frederick County's vision for reducing damages due to natural hazards.

After the HMPC developed mitigation goals for the communities, the committee reviewed the existing mitigation objectives to support accomplishment of the goals (see definitions below). Specific actions to achieve the objectives are discussed in Chapter 5 of the Plan.

Definitions

- "Goals" are general guidelines that explain what you want to achieve. They are usually broad long-term policy statements, representing global visions.
- "Objectives" define strategies or implementation steps to attain the identified goals. Unlike goals, they are specific and measurable.

PUBLIC AWARENESS

GOAL A: Promote public understanding of, support for, and involvement in hazard mitigation activities.

Objective 1

Use countywide public information and education programs to advise citizens on how to protect themselves and their property from natural hazard events.

PLANS AND ORDINANCES

GOAL B: Reduce exposure to natural hazards through local planning and ordinances.

Objective 1

Review and recommend revisions to the County Comprehensive Plan, sub-area plans, municipal plans, and existing ordinances (e.g., zoning, subdivision, and floodplain) as appropriate.

Objective 2

Create an awareness of building to safe standards.

KARST/SINKHOLE

GOAL C: Reduce Frederick County's vulnerability to sinkholes.

Objective 1

Continue to educate Frederick County residents on karst.

Objective 2

Amend the County's wellhead protection ordinance to include strategies that address karst terrain/sinkholes.

Objective 3

Ensure selected storm water management techniques are appropriate for use in areas with karst terrain.

FLOODS

GOAL D: Investigate structural solutions to flooding problems.

Objective 1

Investigate the feasibility of enhancing and/or improving drainage of flood-prone lands.

GOAL E: Develop measures to protect all buildings (commercial, residential, institutional, and industrial) that are in the floodplain.

Objective 1

Continue to ensure that the current building codes, floodplain ordinances, and/or standards are kept current, follow FEMA guidelines, and are properly enforced.

Objective 2

Develop flood mitigation strategies for flood-prone properties.

Objective 3

Strengthen building codes and zoning standards, where needed.

WILDFIRES

GOAL F: Reduce the risk of wildland and urban interface wildfires in the county.

Objective 1

Continue to promote the concept of defensible spaces to county residents.

EVACUATION

GOAL G: Ensure safe and efficient evacuation routes within, to, and from Frederick County.

Objective 1

Coordinate with local, state, and regional partners to provide safe and efficient evacuation routes.

SHELTERS

GOAL H: Provide adequate multi-hazard shelters.

Objective 1

Maintain a list of designated shelters in various communities throughout the County to house residents during an emergency.

COMMUNICATION

GOAL I: Improve severe weather notification in the County.

Objective 1

Improve access in the County to severe weather and emergency notifications.

COMMUNITY-SPECIFIC NEEDS

GOAL J: Identify community-specific needs to reduce risks to various hazards.

Objective 1

The Frederick County Department of Emergency Preparedness will continue to work with all municipalities in the county to identify needs, abilities, and resources to implement appropriate mitigation efforts.

CRITICAL INFRASTRUCTURE AND FACILITIES

GOAL K: Reduce the impact of hazards on critical infrastructure and facilities.

Objective 1

Ensure that critical infrastructure nodes and facilities have reliable power supply.

CHAPTER 5 – MITIGATION PROJECTS

Introduction

This chapter contains the list of mitigation projects that outline the steps necessary to achieve the County's mitigation goals and objectives. The goals, objectives, and projects outlined in this plan are all a part of Frederick County's mitigation strategy. After the goals and objectives were refined, the 2009 mitigation projects were updated and evaluated to reflect their current status. Projects from the 2009 plan that the HMPC chose to carry forward in the 2015 update are shown with a *Status* and *Comment* section and are highlighted in blue; mitigation projects from the 2009 plan that will not be carried forward can be found in Appendix B with a description of individual status. New 2015 projects do not have a *Status* and *Comments* section and are highlighted in green.

Project ideas were evaluated based on technical feasibility (i.e., could they be done and would they solve the problem); cost-effectiveness (i.e., the benefits outweighed the costs); environmental and historic/cultural resource impacts; and political and social acceptance.

A priority level was assigned to each project based on the potential for the projects to be completed given the existing and potential funding; this prioritization method was selected because the HMPC believed it would foster a realistic expectation of what could be accomplished in the next five years. A priority level of High indicates that these projects are currently in progress and have designated funds for completion or require minimal funds to complete (resulting in a high return on investment or measure of cost-effectiveness). A priority level of Medium indicates that the County is likely to receive funding for these particular projects, and if funding is received, the projects will be completed. Lastly, a priority level of Low indicates that these projects will be complete only if outside funding becomes available.

Mitigation Projects by Category

PUBLIC AWARENESS (PA)

Project PA-1
Description of Project: Fund the purchase and delivery of all-hazards public outreach materials, i.e., website, brochures, advertisements, public service announcements, etc., that instruct citizens and businesses on what to do before, during, and after an emergency to prepare, mitigate, respond, and recover.
Applicable Goal: Goal A: Promote public understanding of, support for, and involvement in hazard mitigation activities.
Objective: Use countywide public information and education programs to advise citizens on how to protect themselves and their property from natural hazard events.
Responsible Organizations: Department of Emergency Preparedness.
Estimated Costs: Staff time.
Possible Funding Sources: HMGP.
Timeline for Implementation: Ongoing.
Status Since 2009: Ongoing. *Comments:* Website and public outreach materials kept up to date and are available to citizens. Division of Emergency Management averages about 35 public awareness/outreach events per year.
Priority: High.

Project PA-2
Description of Project: Provide mitigation information in all branches of the County library system and the Book Mobile. Interested property owners can read or check out handbooks or other publications that cover their particular situation. The public library will also archive FEMA publications that address various flood- and other-hazard-related topics. In addition to the community library, the County will provide publications for public use and distribution at Fredrick County buildings and municipalities.
Applicable Goal: Goal A: Promote public understanding of, support for, and involvement in hazard mitigation activities.
Objective: Develop a countywide public information and education program to advise citizens on how to protect themselves and their property from natural hazard events.
Responsible Organizations: Department of Emergency Preparedness, Frederick County Public Library System.
Estimated Costs: No cost incurred.
Possible Funding Sources: No funding required.
Timeline for Implementation: Annually.
Status Since 2009: Completed. *Comments:* FEMA documents addressing flooding have been added to the Frederick County Public Library as a result of the prerequisites for the CRS.
Priority: High.

Project PA-3
Description of Project: Develop a clear, concise, and consistent community-specific threat-based public preparedness message that can be delivered in each municipality using previously-established media sources and public outreach mechanisms.
Applicable Goal: Goal A: Promote public understanding, support, and involvement in hazard mitigation activities.
Objective: Develop a countywide public information and education program to advise citizens on how to protect themselves and their property from natural hazard events.
Responsible Organizations: Department of Emergency Preparedness, municipal leaders.
Estimated Costs: $3,000 per year.
Possible Funding Sources: HMGP.
Timeline for Implementation: 2 to 3 years.
Status since 2009: Not started. *Comments:* No funding.
Priority: Medium.

PLANS AND ORDINANCES (PO)

Project PO-1
Description of Project: Implement mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include, but are not limited to: • Generators • Acquisition of hazard-prone properties • Elevation of flood-prone structures • Minor structural flood control projects • Relocation of structures from hazard-prone areas • Retrofitting of existing buildings and facilities • Infrastructure protection measures • Stormwater management improvements • Advanced warning systems and hazard gauging systems (e.g., weather radios, reverse-911, stream gauges, I-flows) • Targeted hazard education • Flood diversion • Stream restoration
Applicable Goal: Goal B: Reduce exposure of structures, infrastructure, and contents to hazards.
Objective: Create an awareness of building to safe standards.
Responsible Organizations: Department of Emergency Preparedness.
Estimated Costs: Project- and structure-dependent.
Possible Funding Sources: FEMA HMGP funding through a presidential declared disaster; non-disaster FEMA grant funding such as PDM, Repetitive Flood Claims Program, Severe Repetitive Loss Program, Flood Mitigation Assistance Program.
Timeline for Implementation: Ongoing.
Status since 2009: Ongoing. *Comments:* As funding becomes available these types of projects are identified and funded. We have submitted projects for HMGP funding for generators for County and City of Frederick facilities and for advanced warning systems. Using an HMGP grant, we put Alertus warning devices in the main office of every public school in Frederick County. We have also just started a new grant to place Alertus beacons in every staffed County building.
Priority: High.

Project PO-2
Description of Project: Ensure natural hazards are included in the Comprehensive Plan.
Applicable Goal: Goal B: Reduce exposure to natural hazards through local planning and ordinances.
Objective: Review and recommend changes to the County Comprehensive Plan, sub-area plans, municipal plans, and existing ordinances (zoning, subdivision, and floodplain) as appropriate.
Responsible Organizations: Department of Emergency Preparedness, Planning Division.
Estimated Costs: None.
Possible Funding Sources: None.
Timeline for Implementation: Two years.
Priority: Medium.

KARST/LAND SUBSIDENCE (KLS)

Project KLS-1
Description of Project: Fund the purchase and delivery of public outreach materials, i.e., website, brochures, advertisements, public service announcements, etc., that educate citizens and businesses on karsts, how they are formed, and how to identify early indicators and mitigate or respond to karsts.
Applicable Goal: Goal C: Reduce Frederick County's vulnerability to sinkholes.
Objective: Continue to educate Frederick County residents on karst.
Responsible Organizations: Department of Emergency Preparedness.
Estimated Costs: $3,000 per year.
Possible Funding Sources: HMGP.
Timeline for Implementation: 6 months from receipt of secured funding.
Status Since 2009: Ongoing. *Comments:* Karst is one of the hazards we focus on during public education and outreach events.
Priority: Low.

FLASH FLOODS AND FLOODS (F)

Project F-1
Description of Project: Ensure that all County-owned bridges and culverts are maintained on a yearly basis.
Applicable Goal: Goal D: Investigate structural solutions to flooding problems.
Objective: Investigate the feasibility of enhancing and/or improving drainage of flood-prone lands.
Responsible Organizations: Division of Public Works and Department of Highway and Facility Maintenance.
Estimated Costs: $550,000 per year.
Possible Funding Sources: Division of Public Works Operating and Capital budgets.
Timeline for Implementation: Ongoing.
Status since 2009: Ongoing. *Comments:* DPW maintains bridges and culverts on a regular basis and before and after severe weather events.
Priority: High.

Project F-2
Description of Project: Install a series of rainfall and stream gauges to be placed in strategic locations in Frederick County and its municipalities. The gauges will allow enhanced, electronic, NWS monitoring of conditions that may prompt hazardous flash-flooding incidents in Frederick County. In addition, early warning and educational signage and barricades will be purchased for the identified high traffic volume roadways with historically-documented high water hazards.
Applicable Goal: Goal D: Investigate structural solutions to flooding problems.
Objective: Investigate the feasibility of enhancing and/or improving drainage of flood-prone lands.
Responsible Organizations: Department of Emergency Preparedness.
Estimated Costs: $100,000.
Possible Funding Sources: FEMA HMGP funding through a presidential declared disaster; non-disaster FEMA grant funding such as PDM, Repetitive Flood Claims Program, Severe Repetitive Loss Program, Flood Mitigation Assistance Program.
Timeline for Implementation: Ongoing.
Status since 2009: Ongoing. *Comments:* Roads that are most commonly impacted by high water have been marked with signage and DPW will place barricades once the water starts to infringe on the roadway. The Division also maintains a list of roads frequently flooded by high water on the County website. Rainfall gauges have not been purchased because funding is not available.
Priority: Medium.

Project F-3
Description of Project: To maintain county-owned storm water management facilities.
Applicable Goal: Goal D: Investigate structural solutions to flooding problems.
Objective: Investigate the feasibility of enhancing and/or improving drainage of flood-prone lands.
Responsible Organizations: Division of Parks and Recreation.
*Estimated Costs: $*50,000/year for preventative maintenance and the occasional rehabilitation project.
Possible Funding Sources: General fund.
Timeline for Implementation: As funding is provided.
Status since 2009: Ongoing. *Comments:* None.
Priority: High.

Project F-4
Description of Project: Develop structural corrective action plans (paving/elevation programs) for Frederick County's pre-identified frequently flooded roadways.
Applicable Goal: Goal D: Investigate structural solutions to flooding problems.
Objective: Investigate the feasibility of enhancing and/or improving drainage of flood-prone lands.
Responsible Organizations: Department of Emergency Preparedness, DPW, Maryland State Highway Administration.
Estimated Costs: $500,000 per year.
Possible Funding Sources: HMGP/PDM.
Timeline for Implementation: 5 years.
Status since 2009: Ongoing. *Comments:* Frederick County has developed a map layer of frequently flooded roadways and shares that information with citizens through the County's at-a-glance mapping site. Improvements to the GIS map layer are ongoing. Lockable gates have been installed on Michael Mills Road. Two CIP projects are currently being executed to address flooding of Ijamsville Road and Gas House Pike. The priority of this project is medium/high since funding is in place for portions of the CIP and expected to be in place for construction in the upcoming years of the CIP.
Priority: High.

Project F-5
Description of Project: Identify structures in the SFHA and develop a resource guide to educate homeowners on protective measures, including insurance and governmental support opportunities.
Applicable Goal: Goal E: Develop measures to protect all buildings (commercial, residential, and industrial) that are in the floodplain.
Objective: Develop mitigation strategies for flood-prone properties.
Responsible Organizations: Department of Emergency Preparedness, Planning Division.
Estimated Costs: $3,000 per year.
Possible Funding Sources: HMGP.
Timeline for Implementation: 1 year.
Status since 2009: In progress. *Comments:* The Planning and Permits Department performed outreach to some SFHA properties in Point of Rocks and in the Ballenger Creek areas, as well as to several individual citizens when issues arose. As part of the emergency notification system, special data layers have been created that include SFHA properties along the Monocacy and Potomac Rivers.
Priority: Low.

Project F-6
Description of Project: Although no changes to the county floodplain ordinances are required at this time, the State of Maryland recommends that the following changes to the State Model Ordinance be considered to strengthen those ordinances based on lessons learned from Hurricane Isabel. The recommended changes will be included when FEMA's update of the County's floodplain is complete: An increase in the freeboard requirement can be implemented by modifying the Flood Protection Elevation definition. Currently, the standard in the unincorporated areas of the County is 1 foot of freeboard; changing it to 2 or 3 feet will implement a higher level of protection.It is also recommended that "repetitive loss" be added to the development regulated by the county ordinances. This will allow extension of the Increased Cost of Compliance (ICC) coverage in flood insurance policies, which pays up to $30,000 in additional coverage to bring repetitive loss as well as substantially damaged properties into compliance with the floodplain ordinance. The community must be willing to treat repetitive loss properties the same as new and substantially improved structures to qualify. If this is adopted, they must require that repetitive loss properties meet all code requirements as new structures, but they will be making ICC payments available to these structures.
Applicable Goal: Goal E: Develop measures to protect all buildings (commercial, residential, and industrial) that are in the floodplain.
Objective: Continue to ensure that the current building codes, floodplain ordinances, and/or standards are kept current, follow FEMA guidelines, and are properly enforced.
Responsible Organizations: Department of Emergency Preparedness, municipalities.
Estimated Costs: Regular employee pay.
Possible Funding Sources: No funding required.
Timeline for Implementation: 6 to 10 years.
Status Since 2009: Ongoing. *Comments:* Frederick County and its municipalities will adopt the State-recommended changes to the Floodplain ordinance when FEMA completes the map amendment.
Priority: High.

Project F-7
Description of Project: Once the parcel layer is complete, develop a structure layer on GIS that shows the actual structures (not only properties) in the SFHA for the County and the City of Frederick. This should be done in conjunction with the parcel layer. *2015 action:* Maintain structure layer once completed and update as possible.
Applicable Goal: Goal E: Develop measures to protect all buildings (commercial, residential, and industrial) that are in the floodplain.
Objective: Develop flood mitigation strategies for flood-prone properties.
Responsible Organizations: Division of Planning, Department of Emergency Preparedness.
Estimated Costs: Regular employee pay.
Possible Funding Sources: No funding required.
Timeline for Implementation: 2 to 5 years.
Status Since 2009: In progress. *Comments:* Currently in contract with Axis Geospatial to acquire updated building footprint data. Expected August 2015.
Priority: High.

WILDFIRE/WILDLAND URBAN INTERFACE (W)

Project W-1
Description of Project: Improve public education related to wildfire/urban interface fire through the purchase and delivery of education and outreach materials related to Firewise Maryland. This would also include conducting community wildfire protection plans for Frederick County's highest risk areas for wildfire and posting the fire danger reports issued by the Maryland Department of Natural Resources.
Applicable Goal: Goal F: Reduce the risk of wildland and urban interface fires in the County.
Objective: Continue to promote the concept of defensible spaces to County residents.
Responsible Organizations: Frederick County Division of Fire and Rescue Services and Division of Emergency Management.
Estimated Costs: TBD.
Possible Funding Sources: TBD.
Timeline for Implementation: Medium-term.
Priority: Medium.

Project W-2
Description of Project: Improve the rural water supply in areas with significant wildfire/urban interface fire hazards by installing and repairing dry hydrants.
Applicable Goal: Goal F: Reduce the risk of wildland and urban interface wildfires in the County.
Objective: Continue to promote the concept of defensible spaces to County residents.
Responsible Organizations: Division of Fire and Rescue Services and the Division of Emergency Management.
Estimated Costs: TBD.
Possible Funding Sources: State DNR grants, FEMA mitigation grants, and private sector/developer funding.
Timeline for Implementation: Long-term.
Priority: Low.

EVACUATION (E)

Project E-1
Description of Project: Develop a GIS data layer of priority roadways that may be used to evacuate citizens, and ensure that the Evacuation Annex is kept current.
Applicable Goal: Goal G: Ensure safe and efficient evacuation routes within, to, and from Frederick County.
Objective: Coordinate with local, state, and regional partners to provide safe and efficient evacuation routes.
Responsible Organizations: Department of Emergency Preparedness, Planning Division, Sheriff's Office, Division of Public Works.
Estimated Costs: None.
Possible Funding Sources: None.
Timeline for Implementation: Ongoing
Status since 2009: Completed. *Comments:* The Priority Roads GIS data layer is linked to the County street centerline data layer and maintained as updates are received from Division of Public Works.
Priority: High.

Project E-2
Description of Project: Update Frederick County's evacuation plan to include issues such as staging areas, feeding plans for displaced persons, bathrooms, signs, temporary housing, decontamination, etc. An integral part of this plan will be introducing the concept of evacuation in stages. As part of this plan, destination points, such as schools, should be identified for shelters. Points to consider in developing the evacuation plan: experts in emergency planning, transportation planning, and traffic engineering should be involved in developing the plan; canned messages should be developed for use with the public and the media; consideration of closed circuit televisions for the County and the State Highway Administration to help aid traffic flow during evacuations.
Applicable Goal: Goal G: Ensure safe and efficient evacuation routes within, to, and from Frederick County.
Objective: Coordinate with local, state, and regional partners to provide safe and efficient evacuation routes.
Responsible Organizations: Department of Emergency Preparedness, Department of Highways and Transportation, Sheriff's Office.
Estimated Costs: $30,000.
Possible Funding Sources: DHS.
Timeline for Implementation: 2 to 5 years.
Status Since 2009: Not started. *Comments:* This action will focus on information collected from the NCR evacuation plan, which has not been completed.
Priority: Medium.

SHELTERS (S)

Project S-1
Description of Project: Review shelter site and keep partnership agreements current. Identify additional locations that could be equipped and identified as shelters based on the needs and population centers in the County. Work with the Red Cross to conduct an assessment of existing shelters in the County to determine their condition and adequacy with respect to beds, etc. Develop a database of shelters and their locations and determine which ones would need to be retrofitted, particularly with respect to schools. The Red Cross and Frederick County's Emergency Management Department should share information about local shelters on an at least annual basis. Information should include the location of each shelter, its capacity, its back up power availability, and any other relevant information.
Applicable Goal: Goal H: Provide adequate multi-hazard shelters.
Objective: Maintain a list of designated shelters in various communities and ensure there are an adequate number of shelters throughout the County to house residents during an emergency.
Responsible Organizations: Department of Emergency Preparedness, American Red Cross.
Estimated Costs: Regular employee pay, professional consulting fees for architect/engineer.
Possible Funding Sources: None.
Status Since 2009: Ongoing. *Comments*: The EMPAC Shelter and Mass Care Committee has developed a list of primary shelter sites and completed assessments. The State of Maryland has developed a review and retrofit process to equip schools with generators.
Priority: High.

COMMUNICATION (C)

Project C-1
Description of Project: Evaluate and enhance Frederick County's local warning system notifications through multiple mechanisms. The Division of Emergency Management should consider introducing a Reverse 9-1-1 system that would enhance quality of service. Reverse 9-1-1 is an interactive community notification system that enables a recorded telephone message to be sent out to selected areas, blocks, or neighborhoods in the event of an emergency. The system is a quick and efficient way of contacting and notifying residents of a potentially serious problem near their homes or businesses. It allows the police department to quickly send out time-critical messages rather than going door-to-door. Messages can be sent to a select jurisdiction or the entire county and includes a convenient TTY/TDD feature capable of sending information to the hearing impaired. The system is sophisticated enough to indicate whether a call was received or whether a message was left on an answering machine. It also can be programmed to keep trying until a call has been successfully received. Develop a countywide audible alert system. Evaluative alternatives such as e-911, etc. Identify major developments, municipalities, and other populated centers for the installation of these early warning devices. Develop a booklet to educate the public on meanings of warnings and appropriate actions to take before, during, and after a disaster or emergency.
Applicable Goal: Goal I: Improve severe weather notification in the community.
Objective: Improve access in the County to severe weather and emergency notifications.
Responsible Organizations: Department of Emergency Preparedness, Emergency Communications.
Estimated Costs: As funding becomes available.
Possible Funding Sources: HMGP, DHS's Emergency Services Performance Grant (EMPG).
Timeline for Implementation: 2 to 5 years.
Status Since 2009: Completed. *Comments:* Frederick county purchased a notification system and sends out warnings for severe weather. The county has also partnered with some of the municipalities that are also using the system. A study of outdoor warning sirens was completed and it was determined that it was not feasible to install at least 28 sirens countywide. The County did automate severe weather alerting for the 3 municipalities that have sirens.
Priority: High.

CRITICAL INFRASTRUCTURE AND FACILITIES (CIF)

Project CIF-1
Description of Project: Reduce the impact of power outages on government owned critical infrastructure and facilities.
Applicable Goal: Goal K: Reduce the impact of hazards on critical infrastructure and facilities.
Objective: Ensure that critical infrastructure nodes and facilities have reliable power supply.
Responsible Organizations: Division of Emergency Management and agencies that operate/maintain the critical infrastructure/facility.
Estimated Costs: TBD.
Possible Funding Sources: HMGP.
Timeline for Implementation: Long-term.
Priority: Low.

COMMUNITY-SPECIFIC NEEDS

City of Brunswick

Project Brunswick-1
Description of Project: Identify, map in GIS, and prioritize high yield options to reduce the impact of stormwater flooding throughout the City, which is characterized by steep flood-prone slopes leading downstream to the Potomac River.
Applicable Goal: Goal D: Investigate Structural Solutions to Flooding Problems; Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: Investigate the feasibility of enhancing and/or improving drainage of flood-prone lands.
Responsible Organizations: Administration Department (Planning Office and GIS).
Estimated Costs: $6,000 initial draft, plus engineering of high priorities.
Possible Funding Sources: City discretionary funds or FEMA/MEMA mitigation funding.
Timeline for Implementation: 18 months.
Priority: Medium.

Project Brunswick-2
Description of Project: Consider providing battery-operated radios, flashlights, etc., to residents, free-of-charge.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: The Department of Emergency Preparedness will continue to work with all the municipalities in the County to identify needs, abilities, and resources to implement appropriate mitigation efforts.
Responsible Organizations: City of Brunswick, Department of Emergency Preparedness.
Estimated Costs: Regular employee pay.
Possible Funding Sources: General fund.
Timeline for Implementation: None.
Status Since 2009: Not started. *Comments:* No funding.
Priority: Low.

Project Brunswick-3
Description of Project: Revise existing ordinances as appropriate for Brunswick. Sections that should be improved and areas where attention should be focused have been elaborated in the Mitigation Capability Analysis section at the end of Chapter 3 of this Plan. Consider incorporating these changes during the next plan or ordinance amendment.
Applicable Goal: Goal B: Reduce exposure to natural hazards through local planning and ordinances.
Objective: Review and recommend changes to the County Comprehensive Plan, sub-area plans and municipal plans, existing ordinances (zoning, subdivision, and floodplain) as appropriate.
Responsible Organizations: Individual municipalities, Department of Planning, Department of Engineering.
Estimated Costs: Regular employee pay.
Possible Funding Sources: No funding required.
Timeline for Implementation: 6 to 10 years.
Status Since 2009: In progress. *Comments*: A comprehensive review of the City's ordinances began in July 2015. While the review is in the early stages, attention will be given to areas identified in the Mitigation Capability Analysis section. Proposed changes will be considered for inclusion/adoption when the code review is complete.
Priority: High.

Project Brunswick-4
Description of Project: To ensure that wind damage is minimal to city-owned facilities; continue tree-trimming program and tree maintenance in City of Brunswick.
Applicable Goal: Goal B: Reduce exposure of structures, infrastructure, and contents to hazards.
Objective: Create an awareness of building to safe standards.
Responsible Organizations: City of Brunswick Department of Public Works.
Estimated Costs: $3,000 per year.
Possible Funding Sources: General Fund or HMGP.
Timeline for Implementation: 1 year.
Status since 2009: In progress. *Comments:* The City initiated several tree trimming/culling projects during 2015 and previously. Discussions are underway for the City to designate a Licensed Tree Expert to assist with ensuring this a routine business practice.
Priority: Medium.

Town of Burkittsville

Project Burkittsville-1
Description of Project: Replacement of failing CMP storm drain along East Main St. and replacement of 3 box culverts.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: Improve safety regarding traffic, pedestrian, lighting, and stormwater management while bringing everything up to today's standards.
Responsible Organizations: Town of Burkittsville.
Estimated Costs: $227,000.
Possible Funding Sources: TBD; FEMA PDM; HMGP.
Timeline for Implementation: Phase 1 in progress; Phase 2: 12 to 18 months.
Priority: High.

Town of Emmitsburg

Project Emmitsburg-1
Description of Project: Adoption of an updated Comprehensive Plan to encourage sustainable growth practices and reduce exposure to natural hazards.
Applicable Goal: Goal B: Reduce exposure to natural hazards through local planning and ordinances.
Objective: Review and recommend revisions to the County Comprehensive Plan, sub-area plans, municipal plans, and existing ordinances (zoning, subdivision, and floodplain) as appropriate.
Responsible Organizations: Planning.
Estimated Costs: Staff time.
Possible Funding Sources: N/A.
Timeline for Implementation: 2015.
Priority: High

Project Emmitsburg-2
Description of Project: Adoption of a “Cluster Development Ordinance” to strengthen flood plain buffers and limit infrastructure maintenance.
Applicable Goal: Goal E: Develop measures to protect all buildings (commercial, residential, institutional, and industrial) that are in the floodplain.
Objective: Strengthen building codes and zoning standards, where needed.
Responsible Organizations: Planning.
Estimated Costs: Staff time.
Possible Funding Sources: N/A.
Timeline for Implementation: 2015.
Priority: High

Project Emmitsburg-3
Description of Project: Coordinate with the State Highway Administration (SHA) to assist in the rebuilding of the bridge over Flat Run to reduce potential flooding on East Main Street.
Applicable Goal: Goal G: Ensure safe and efficient evacuation routes within, to, and from Frederick County.
Objective: Coordinate with local, state, and regional partners to provide safe and efficient evacuation routes.
Responsible Organizations: SHA, Town staff.
Estimated Costs: $1.2 million.
Possible Funding Sources: State of Maryland.
Timeline for Implementation: 2017.
Priority: Medium

Project Emmitsburg-4
Description of Project: Purchase a GIS system and create a complete infrastructure monitoring system. Then, add an early warning notification system to subscribers for emergency notices.
Applicable Goal: Goal I: Improve severe weather notification in the County.
Objective: Improve access in the County to severe weather and emergency notifications.
Responsible Organizations: Town staff.
Estimated Costs: TBD.
Possible Funding Sources: State of Maryland.
Timeline for Implementation: 2018.
Priority: Low

City of Frederick

Project City of Frederick-1
Description of Project: Identify 5 areas of localized flooding (not mapped by FEMA). Develop means of mitigation or determine course of action if mitigation is not possible. Possible strategies include making improvements to existing drainage systems to relieve flooding or purchasing property where mitigation is not possible.
Applicable Goal: Goal E: Develop measures to protect all buildings (commercial, residential, institutional, and industrial) that are in the floodplain.
Objective: Develop flood mitigation strategies for flood-prone properties.
Responsible Organizations: Public Works.
Estimated Costs: $500,000-$1,000,000 for study and conceptual designs.
Possible Funding Sources: FEMA mitigation grants; city funds.
Timeline for Implementation: Mid-term.
Priority: Medium.

Project City of Frederick-2
Description of Project: Develop a flood warning system for citizens who do not use cell phone. Coordination with Emergency Services to utilize existing public warning systems.
Applicable Goal: Goal I: Improve severe weather notification in the County.
Objective: Improve access in the County to severe weather and emergency notifications.
Responsible Organizations: Emergency Services.
Estimated Costs: $100,000-250,000.
Possible Funding Sources: City funds; FEMA Preparedness grants.
Timeline for Implementation: Mid-term.
Priority: Low.

Project City of Frederick-3
Description of Project: Complete the Carroll Creek Levee. The completion of the project will protect an additional 48 properties. 2015 action: Obtain approval for final construction of Carroll Creek Levee from USACE.
Applicable Goal: Goal E: Develop measures to protect all buildings (commercial, residential, institutional, and industrial) that are in floodplain.
Objective: Develop flood mitigation strategies for flood-prone structures.
Responsible Organizations: City of Frederick – Planning, Engineering, Public Works, Maryland Department of the Environment, Maryland Historical Trust, Federal agencies.
Estimated Costs: Staff time.
Possible Funding Sources: HMGP, FMA.
Timeline for Implementation: Short-term
Status Since 2009: Ongoing. *Comments:* Carroll Creek Levee has been constructed. City must obtain approval of final construction from USACE.
Priority: High.

Project City of Frederick-4
Description of Project: Retrofit drainage where major roads frequently flood: • West Patrick Street opposite West Frederick Middle School (Maryland Route 144 – major arterial road). • Gas House Pike near confluence of Carroll Creek and Monocacy River (construction of new Monocacy Boulevard might relieve burden). This has been planned but not built. • Waverly Drive (Frederick Towne Mall, major city mall subject to flooding by Rock Creek).
Applicable Goal: Goal E: Develop measures to protect all buildings (commercial, residential, institutional, and industrial) that are in floodplain.
Objective: Develop flood mitigation strategies for flood-prone structures.
Responsible Organizations: City of Frederick – Public Works, Engineering, Planning.
Estimated Costs: City engineer to do preliminary analysis to determine costs at each location.
Possible Funding Sources: HMGP, FMA.
Timeline for Implementation: 6 to 10 years.
Status Since 2009: Ongoing. *Comments:* • Gas House Pike near confluence of Carroll Creek and Monocacy River - Monocacy Boulevard design is nearly complete. City plans to release for bidding no later than December 2015. • Waverly Drive - Developer working through planning process for the redevelopment of site to remove commercial properties from floodplain.
Priority: High.

Project City of Frederick-5
Description of Project: Develop a GIS map of all city sinkholes. Require that sinkhole topography be included in all site plans in affected areas.
Applicable Goal: Goal B: Reduce exposure to natural hazards through local planning and ordinances.
Objective: Review and recommend revisions to the County Comprehensive Plan, sub-area plans, and municipal plans, and existing ordinances (zoning, subdivision, and floodplain) as appropriate.
Responsible Organizations: City of Frederick – Engineering, Planning.
Estimated Costs: Regular employee pay.
Possible Funding Sources: No funding required.
Timeline for Implementation: 1 year.
Status Since 2009: Ongoing. *Comments:* Reported sinkholes are mapped and added to a layer in City GIS.
Priority: Medium.

Project City of Frederick-6
Description of Project: Middletown, Walkersville, and the City of Frederick should get together and urge the county to adopt a sinkhole ordinance.
Applicable Goal: Goal B: Reduce exposure to natural hazards through local planning and ordinances.
Objective: Review and recommend revisions to the County Comprehensive Plan, sub-area plans, municipal plans, and existing ordinances (zoning, subdivision, and floodplain) as appropriate.
Responsible Organizations: Town of Middletown, Town of Walkersville, City of Frederick – Engineering, Public Works, Legal, Mayor's Office.
Estimated Costs: Regular employee pay.
Possible Funding Sources: No funding required.
Timeline for Implementation: 6 to 10 years.
Status Since 2009: No action. *Comments:* None.
Priority: Medium.

Project City of Frederick-7
***Description of Project*: Establish a regular maintenance inspection and preventive program for sinkholes on/near city streets.**
Applicable Goal: Goal B: Reduce exposure to natural hazards through local planning and ordinances.
Objective: Review and recommend revisions to the County Comprehensive Plan, sub-area plans, municipal plans, and existing ordinances (zoning, subdivision, and floodplain) as appropriate.
Responsible Organizations: City of Frederick – Streets and Grounds.
Estimated Costs: Regular employee pay.
Possible Funding Sources: No funding required.
Timeline for Implementation: 1 year.
Status Since 2009: No action. *Comments:* None.
Priority: Medium.

Town of Middletown

Project Middletown-1
Description of Project: Reduce potential flooding damage by including waterbody buffer requirements in all zoning districts.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: Propose and enact a zoning text amendment to allow for additional waterbody buffers in all zoning districts.
Responsible Organizations: Planning Commission of Middletown.
Estimated Costs: $1,000 for legal review and public hearing scheduling process.
Possible Funding Sources: Town's General Fund.
Timeline for Implementation: 6 to 12 months.
Priority: High.

Town of Mount Airy

Project Mount Airy-1
Description of Project: Conduct a Vulnerability Assessment of the Town's infrastructure highlighting weaknesses in the system.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: Identify opportunities to address weaknesses and determine how to address through future investments.
Responsible Organizations: Administration/Engineering/Public Works.
Estimated Costs: No cost, in-house assessment.
Possible Funding Sources: N/A.
Timeline for Implementation: FY 2016-FY 2019.
Priority: High.

Project Mount Airy-2
Description of Project: Install/replace emergency backup generators at all critical facilities.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: The Department of Emergency Preparedness will continue to work with all the municipalities in the county to identify needs, abilities, and resources to implement appropriate mitigation efforts.
Responsible Organizations: Town of Mount Airy Communications & Technology Committee, Department of Water and Sewer.
Estimated Costs: Varies based on size, horse power, etc.
Possible Funding Sources: HMGP, Department of Homeland Security (DHS) grant.
Timeline for Implementation: 2 to 5 years.
Status Since 2009: In progress. *Comments*: Water stations are done. Sewer stations are done. Town Hall is in progress.
Priority: Medium.

Project Mount Airy-3
Description of Project: Install a SCADA system to monitor all critical public works facilities. This is a type of computer monitoring system for water and wastewater system operations. From a desk top and/or laptop computer, all pumps, flows, chemical feeds, power usage, security door contacts, fire detectors, etc., could be monitored.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: The Department of Emergency Preparedness will continue to work with all the municipalities in the County to identify needs, abilities, and resources to implement appropriate mitigation efforts.
Responsible Organizations: Town of Mount Airy Communications & Technology Committee, Division of Public Works, Department of Water and Sewer.
Estimated Costs: Unknown.
Possible Funding Sources: DHS Emergency Services Performance Grant (EMPG).
Timeline for Implementation: 1 year.
Status Since 2009: In progress. *Comments*: None.
Priority: Medium.

Town of Myersville

Project Myersville-1
Description of Project: Conduct stream restoration of Catoctin Creek in Doubs Meadow Park to protect pedestrian trail and fields.
Applicable Goal: Goal D: Investigate structural solutions to flooding problems.
Objective: Investigate the feasibility of enhancing and/or improving drainage of flood-prone lands.
Responsible Organizations: Town of Myersville, NWFS.
Estimated Costs: $40,000.
Possible Funding Sources: Myersville, USFW, NRCS, USACE, FEMA.
Timeline for Implementation: Within 6 year CIP.
Priority: Medium.

Project Myserville-2
Description of Project: Repair utility line exposed by storm-related events in Grindstone Run.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: The Frederick County Department of Emergency Preparedness will continue to work with all municipalities in the County to identify needs, abilities, and resources to implement appropriate mitigation efforts.
Responsible Organizations: Myersville.
Estimated Costs: $100,000.
Possible Funding Sources: Myersville.
Timeline for Implementation: Within 6 year CIP.
Priority: Medium.

Project Myersville-3
Description of Project: Install approximately 2,000 linear feet force main 8 inch waterline and hydrant connection for fire flow suppression on Milt Summers Road to serve significant commercial and gas utility company facilities.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: Eliminate use and drainage of potential contaminated water source in karst area, limit exposure of potential flammable property uses to wildland burning.
Responsible Organizations: Town of Myersville, private development partners, TBD.
Estimated Costs: $220,000.
Possible Funding Sources: Private investment.
Timeline for Implementation: End of calendar year 2016.
Priority: High.

Town of New Market

Project New Market-1
Description of Project: Implementation of a recently signed developer agreement to design and construct a new parkway. This will create an alternate east-west route through town and create new town evacuation route options, thereby mitigating problems that could occur in town during an emergency with a blockage of Main Street/Maryland Route 144.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: Increase evacuation options.
Responsible Organizations: Town of New Market; private developer.
Estimated Costs: TBD.
Possible Funding Sources: Private developer.
Timeline for Implementation: Short-term.
Priority: High.

Village of Rosemont

Project Rosemont-1
Description of Project: Post hazard mitigation information on village website and send out emails to the Rosemont resident listserv.
Applicable Goal: Goal A: Promote public understanding, support, and involvement in hazard mitigation activities.
Objective: Use countywide public information and education programs to advise citizens on how to protect themselves and their property from natural hazard events.
Responsible Organizations: Village of Rosemont.
Estimated Costs: Staff time.
Possible Funding Sources: N/A.
Timeline for Implementation: Ongoing.
Priority: High.

Town of Thurmont

Project Thurmont-1
Description of Project: Reinforce stream banks along Hunting Creek in locations where the stream passes through town. Banks are eroding causing risks to private homes and businesses that are adjacent to the stream.
Applicable Goal: Goal D: Investigate structural solutions to flooding problems.
Objective: Investigate the feasibility of enhancing and/or improving drainage of flood-prone lands.
Responsible Organizations: Town of Thurmont, MDE, DNR.
Estimated Costs: $350,000.
Possible Funding Sources: MDE Grants, DNR Grants, Town of Thurmont CIP.
Timeline for Implementation: Medium-term.
Priority: Medium.

Project Thurmont-2
Description of Project: Revise existing ordinances as appropriate for Thurmont. Sections that should be improved and areas where attention should be focused have been elaborated in the Mitigation Capability Analysis section at the end of Chapter 3 of this Plan. Consider incorporating these changes during the next Plan or ordinance amendment.
Applicable Goal: Goal B: Reduce exposure to natural hazards through local planning and ordinances.
Objective: Review and recommend changes to the County Comprehensive Plan, sub-area plans, municipal plans, and existing ordinances (zoning, subdivision, and floodplain) as appropriate.
Responsible Organizations: Individual municipalities, Department of Planning, Department of Engineering.
Estimated Costs: Regular employee pay.
Possible Funding Sources: No funding required.
Timeline for Implementation: 3 to 5 years.
Status Since 2009: In progress. *Comments*: Planned for review in FY16 and/or FY17.
Priority: Medium.

Project Thurmont-3
Description of Project: Obtain generators of various sizes for wastewater treatment and for water treatment facilities.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: The Department of Emergency Preparedness will continue to work with all the municipalities in the county to identify needs, abilities, and resources to implement appropriate mitigation efforts.
Responsible Organizations: Town of Thurmont, Department of Emergency Preparedness.
Estimated Costs: Varies based on size, horse power, etc.
Possible Funding Sources: Department of Homeland Security's Emergency Services.
Timeline for Implementation: 1 year.
Status Since 2009: In progress. *Comments:* Wastewater has been completed. Plans to upgrade the connection capabilities for generators to Wells #7 and #8 in FY16.
Priority: High.

Project Thurmont-4
Description of Project: Coordinate with local fire and rescue services to develop a community emergency response plan.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: The Department of Emergency Preparedness will continue to work with all the municipalities in the County to identify needs, abilities, and resources to implement appropriate mitigation efforts.
Responsible Organizations: Town of Thurmont, Department of Emergency Preparedness.
Estimated Costs: Regular employee pay.
Possible Funding Sources: None.
Timeline for Implementation: 2 to 5 years.
Status Since 2009: In progress. *Comments:* Completed for large events. Overall response plan planned for FY16.
Priority: Medium.

Project Thurmont-5
Description of Project: Seek funding to mitigate flooding concerns at the Public Works Office via relocation, elevation, or levee construction.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: The Department of Emergency Preparedness will continue to work with all the municipalities in the county to identify needs, abilities, and resources to implement appropriate mitigation efforts.
Responsible Organizations: Town of Thurmont, Department of Emergency Preparedness.
Estimated Costs: Varies by type of mitigation measure.
Possible Funding Sources: FMA, HMGP, PDM.
Timeline for Implementation: 2 to 5 years.
Status Since 2009: In progress. *Comments:* Some stream bank stabilization completed in FY15. Seeking funding for more similar work in FY17.
Priority: Low.

Town of Walkersville

Project Walkersville-1
Description of Project: Review and update Town Design Manual.
Applicable Goal: Goal B: Reduce exposure to natural hazards through local planning and ordinances.
Objective: Review and recommend revisions to the County Comprehensive Plan, sub-area plans, municipal plans, and existing ordinances (zoning, subdivision, and floodplain) as appropriate.
Responsible Organizations: Town of Walkersville Planning and Public Works.
Estimated Costs: TBD.
Possible Funding Sources: Town funds.
Timeline for Implementation: Medium-term.
Priority: Medium.

Project Walkersville-2
Description of Project: Build new water plant with micro-filtration and ion exchange to replace aging plant. Due to karst geology, the town's water supply (groundwater) is vulnerable to contamination.
Applicable Goal: Goal C: Reduce Frederick County's vulnerability to sinkholes.
Objective: N/A
Responsible Organizations: Town of Walkersville.
Estimated Costs: TBD.
Possible Funding Sources: Town funds, state grants and loans.
Timeline for Implementation: Medium-term.
Priority: Medium.

Project Walkersville-3
Description of Project: Conduct a study to assess flooding on Biggs Ford Road from Glade Creek to Kenneth Drive. Develop alternatives to reduce flooding impacts.
Applicable Goal: Goal D: Investigate structural solutions to flooding problems.
Objective: Investigate the feasibility of enhancing and/or improving drainage of flood-prone lands.
Responsible Organizations: Town of Walkersville.
Estimated Costs: TBD.
Possible Funding Sources: TBD.
Timeline for Implementation: Long-term.
Priority: Low.

Project Walkersville-4
Description of Project: Develop a plan and procedure for inspecting and cleaning out storm drains before storm events.
Applicable Goal: Goal D: Investigate structural solutions to flooding problems.
Objective: Investigate the feasibility of enhancing and/or improving drainage of flood-prone lands.
Responsible Organizations: Town of Walkersville Public Works.
Estimated Costs: TBD.
Possible Funding Sources: Town funds.
Timeline for Implementation: Short-term.
Priority: High.

Town of Woodsboro

Project Woodsboro-1
Description of Project: Replace a damaged well for the residents of Woodsboro.
Applicable Goal: Goal J: Identify community-specific needs to reduce risks to various hazards.
Objective: To reduce risk of drought impacts and wildfire/urban interface fire impacts through ensuring water supply.
Responsible Organizations: Town.
Estimated Costs: TBD.
Possible Funding Sources: Town.
Timeline for Implementation: Short-term.
Priority: Medium.

CHAPTER 6 – Plan Maintenance

Introduction

This document is intended to serve as Frederick County's road map for evaluating hazards, identifying resources and capabilities, selecting appropriate actions, and developing and implementing mitigation measures to eliminate or reduce future damage from those hazards in order to protect the health, safety, and welfare of the residents in the community.

This chapter identifies procedures for keeping this plan current and updated at least once every 5 years, as prescribed by the DMA2K.

Monitoring, Evaluating, and Updating the Plan

Plan maintenance requires an ongoing effort to monitor and evaluate the implementation of the Plan, and to update the Plan as progress, roadblocks, or changing circumstances are recognized. The Department of Emergency Preparedness will be responsible for monitoring and updating the Plan, and the HMPC will play an advisory role available for oversight. The team should accomplish the following:

- The Department of Emergency Preparedness will review the plan yearly, specifically the mitigation action plan and Responsible Organization designation in each project.
- If extra funding becomes available, the Department of Emergency Preparedness will re-visit the inactive 2009 mitigation strategies for reinstatement.
- If needed, the Department of Emergency Preparedness will request a meeting with the HMPC and the public to do a formal review of the plan.
- A 5 year written update should be submitted to the state and FEMA Region III, unless a disaster or other circumstances (e.g., change in regulations) leads to a different time frame.

The timing of the yearly reviews should coincide with either the anniversary of the approval date of this plan or another date chosen by the committee. Re-prioritization of projects may be needed as high priority mitigation actions are completed.

As described above, the Department of Emergency Preparedness and primary responsible organizations for each project listed in Chapter 5 will be responsible for evaluating progress in implementing mitigation projects. The Department of Emergency Preparedness, during its annual review, may also identify corrective actions for projects. In addition, the Department of Emergency Preparedness should review its organizational composition annually and adjust membership, if needed.

The Department of Emergency Preparedness will determine at its annual meeting if a formal update of the plan is required. At a minimum, the plan will be updated every 5 years. Factors to consider when determining if an update is necessary include:

- Decreased vulnerability as a result of implementing recommended actions;
- Increased vulnerability as a result of failed or ineffective mitigation actions;
- Increased vulnerability as a result of new development;
- New state/federal laws, policies, or programs;

- Changes in resource availability; and/or
- Applicability of goals/objectives/strategies.

A major event such as a presidentially declared disaster may trigger a need to review the plan. If such an event affects Frederick County, the Department of Emergency Preparedness will coordinate to determine how best to review and update the plan. Major changes to the plan will be submitted to the state and to FEMA Region III.

Public Involvement

Public notice of the annual review will be given and public participation will be invited. At a minimum, notification will be through web postings and press releases to local media outlets, primarily newspapers. In addition, an annual event will be held to publicize progress on implementing the mitigation plan. This event could be timed to coincide with the anniversary of a significant event or annual awareness event (e.g., Hurricane Preparedness Week). The county will also post a link to the mitigation plan on the Department of Emergency Preparedness's website. It is recommended that the county's website serve as a means of communication by providing information about mitigation initiatives and updates to the projects and the Plan itself.

APPENDICES

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Appendix A: Hazard Histories and Vulnerability Assessment

The information contained in Appendix A is data from the 2004 and 2009 Frederick County Mitigation Plans, organized by hazard category. The information shown has not been changed or updated. Hazards are only listed if they had historical data included in the plan. For hazard history after 2009, please refer to Chapter 2.

Atmospheric Hazards

Extreme Heat

- On July 17 and 18, 2006, a hot and very humid air mass seeped into the mid-Atlantic. The heat index value climbed to 105 degrees both afternoons. Emergency response officials reported sporadic incidents of heat-related illness, such as shortness of breath and heat exhaustion, throughout the Washington/Baltimore Metropolitan region. Three deaths were attributed directly to this heat wave.
- Between August 1 and 3, 2006, excessive heat conditions occurred across much of Maryland. Afternoon heat index values ranged between 105 to as high as 115 degrees. Six people died in central Maryland due to the excessive heat conditions during this heat wave. Five people, including one player, were rushed to the hospital during a baseball game due to heat-related illnesses.
- On August 27, 2008, a hot and humid air mass developed over the mid-Atlantic ahead of a strong cold front on August 25. Temperatures climbed into the mid 90s by noon. These temperatures combined with high humidity created heat index values of 105.
- On August 22, 2002, high temperatures rose into the mid 90s and heat index values soared to near 105 degrees during the afternoon. Three people in Frederick County died as a result of the excessive heat. No damage to property or crops was reported.
- High pressure sitting off the Atlantic coastline pumped hot and humid air into the region between August 12 and 19, 2002. Temperatures soared well into the 90s during the afternoon each day and heat index values approached 100 degrees in Frederick County and neighboring areas. Four Marylanders died during the 8 day heat wave. No property or crop damage was reported.
- High pressure off the Atlantic Coast pumped hot and humid air into the Mid-Atlantic region, causing high temperatures to reach between 92 and 100 degrees between August 1 and August 5, 2002; heat indices soared to between 98 and 110 degrees. In Frederick County, 11 people participating in an outdoor activity in Ijamsville were treated for heat illnesses. The heat was also blamed for buckling pavement on Interstate 70 near the Maryland Route 355 exit. Several regional power companies noted record energy consumption during this heat wave, the hottest in 5 years.
- A large area of high pressure sat off the Mid-Atlantic coast during the last week of July 2002. This caused a warm and moist south wind to blow into the region for several days, resulting in another heat wave in the Frederick County region. The hottest days were the 28th and 29th of July, when temperatures rose into the 90s and heat index values reached 100 to 110 degrees. Power companies reported record electricity use on the 29th. Three fatalities were recorded in Maryland.
- High pressure remained stationary off the Delmarva coastline during the first week of July 2002. This resulted in a prolonged period of hot and humid weather across the Mid-Atlantic region. Between July 2 and 4, high temperatures rose into the lower to middle 90s and dew

points reached into the lower 70s. This resulted in heat index values reaching 100 to 110 degrees during the afternoon. Twenty other people were treated at hospitals for heat illnesses countywide between July 2nd and 4th. Twenty-one fatalities were recorded in Maryland. There was no damage to crops or property.

Thunderstorms

- On June 4, 2008, a local newspaper reported several roofs blown off barns on Brentland Road. A stalled front resided across the mid-Atlantic during the afternoon and evening of June 4, allowing moisture and instability to pool along the boundary. This combined with several strong upper level disturbances resulted in numerous thunderstorms during the afternoon and evening. Many of these thunderstorms became severe. Damages were reported at $50,000.
- On March 5, 2008, Frederick County Emergency Management reported a barn roof and garage collapse. Three telephone poles were downed in the unincorporated city of Adamstown. Several lines of thunderstorms crossed the region from the evening of March 4 through the early morning of March 5. Heavy rain led to several road closures due to flooding and also caused several basements to flood. Wind gusts in excess of 50 mph were measured at several locations statewide. There were numerous reports of trees and power lines down across northern and central Maryland.
- On February 4, 2006, a newspaper report indicated significant damage to a log house near Libertytown in Frederick County. A large old oak tree was downed, as well as a few other smaller trees. Trees and power lines also were downed near Ridgeville and Westminster. Damages were reported to approach $100,000.
- On July 10, 2001, a 69 mph wind gust was recorded in Emmitsburg where 2 inches of rain fell. Southeast of Emmitsburg, a 100-by-300-foot barn under construction on Dry Bridge Road collapsed. Three workers inside the structure were injured. Trees were downed near Rocky Ridge south of Thurmont.
- On May 5, 1991, winds were reported gusting at 70 mph in the northwestern portion of the County. Officials estimated damages to be at least $100,000. Many trees were uprooted and power lines down. One woman was injured by a falling tree. Water supply was interrupted for a day after a tree, whose roots were wrapped around an 8 inch line, was toppled.
- On February 4, 1998, a powerful nor'easter, carrying copious amounts of moisture from the Gulf of Mexico and Caribbean region, dumped between 2 and 4 inches of rain across much of Maryland between the foothills and the Chesapeake Bay. Several counties in Maryland, including Frederick County, were affected. Minor sewage backups were reported farther north in Frederick County. A tractor-trailer flipped over along Interstate 70 in western Frederick County near the Myersville exit (Maryland Route 17). The total property damage incurred across the State totaled $145,000 and crop damage was $200,000.
- On July 19, 1996, a supercell that was producing weak to moderate tornadoes across southern Washington and Frederick Counties had an associated rear-flank downburst that struck immediately west of the tornado track. Numerous trees were uprooted or snapped over a wide area from just west of Rosemont to the banks of the Potomac River. Wind speeds maximized along the shoreline, likely a result of a channeling effect through the mountain gap just east of Harpers Ferry, West Virginia. Power outages were substantial in these areas; 10,000 customers in Loudoun County, Virginia, and Frederick County, Maryland, were briefly without electricity. The total crop damage incurred was $50,000 and property damage was $25,000.

- On July 21, 1998, a small but potent line of severe thunderstorms raced from western Maryland through the Washington, DC, metropolitan region, producing wind gusts between 60 and 70 mph along the leading edge. The storm gained strength as it plowed southeast into Frederick and Montgomery Counties. In Frederick County, damage included felled scattered trees and power lines in the Middletown/Braddock Heights area. More substantial damage occurred in the southern portion of the City of Frederick, where two roofs partially collapsed at a shopping center near the intersection of Maryland Route 85 and Interstate 270. An unfastened trailer was flipped off cinder block supports and fell onto an automobile, pinning the car against a curb. Homes at a nearby neighborhood sustained minor damage, including one whose garage was partially destroyed. The total property damage was approximately $90,000.

Extreme Wind Events

- On December 16, 2007, wind gusts over 60 mph knocked out power, and Frederick County Emergency Management reported nearly 30 reports of trees down across the county. Damages were intensified in areas that had significant ice accumulations. Property damages approached $10,000.
- Large trees were knocked down by 55 mph wind gusts from a strong cold front on December 1, 2006. Trees were downed along Gashouse Pike east of the City of Frederick and along Rocky Springs and Yellow Springs Roads to the north of the city. Property damage was estimated to be $30,000. A strong cold front brought very strong winds to the county on February 17, 2006. Wind gusts of over 50 mph were reported with scattered power outages from downed trees and power lines. Property damage exceeded $140,000.
- Tens of thousands of people were without power for an extended period of time on January 14, 2006, as a strengthening low pressure area moved up the northeast coast. Widespread damages and power outages occurred throughout Maryland with this event. Winds gusted to over 60 mph, and $1.8 million in property damage was reported.
- High winds occurred on March 14, 1993, as the “Blizzard of 1993” moved through the region. Wind gusts over 60 mph created snow drifts up to 10 feet. Nearly $500,000 in property damage occurred.
- On November 11, 1995, a strong cold front ripped through the region creating wind gusts to hurricane force (74 mph). Property damage in the County climbed to $70,000.
- A severe wind event occurred on April 23, 1996, resulting in over 30,000 Baltimore Gas and Electric customers without power. Damages over $100,000 were reported.
- Strong winds in excess of 30 mph knocked down a healthy tree just south of Mount Airy, which just missed a nearby home. A deteriorating and aging silo was also knocked down. Damages were $15,000.
- A strong coastal storm rolled through the state on February 4, 1998, resulting in sustained winds of 35 mph and gusts in excess of 50 mph. Dozens of trees fell across the County and nearly 15,000 people were without power at the height of the storm. A tractor trailer was flipped over by the wind on Interstate 70 near the Myersville exit. Damages were near $350,000 from the storm.
- One person was injured on February 24, 1998, when a wall fell in an unfinished townhome during a severe windstorm. Property damage was $70,000.
- On February 11, 2000, strong cold fronts passed through the region with winds in excess of 55 mph. Trees were reportedly down on area roadways in Emmitsburg, New Market and

Middletown. Over 1,000 people were without power in the County and property damage was $22,000.

- A vigorous cold front crossed the County on December 12, 2000, resulting in large tree limbs being knocked down onto U.S. Route 15 near Point of Rocks. A wind gust of 44 mph was reported at Frederick Airport. Property damages were $35,000.
- A severe wind event occurred on February 1, 2002, with a wind gust of 54 mph at Frederick Airport. There were trees and power lines reported down across the County, along with scattered power outages.
- Strong downslope winds from the Appalachian Mountains gusted to over 50 mph on January 9, 2003. Tree limbs were downed near Brunswick and wires were downed in Walkersville and Mount Pleasant.
- High winds occurred on November 13, 2003, as a strong cold front plowed through the region. A truck was blown over on U.S. Route 15. Over 150,000 homes and businesses were without power at the height of the storm in Maryland.

Hailstorms

- On June 26, 2009, ping-pong-ball-sized hail was reported near Walnut Ridge as a result of a potent cold front combined with plenty of instability that triggered severe thunderstorms.
- On July 16, 2007, penny- and nickel-sized hail was spotted in Brunswick. Numerous showers and thunderstorms developed across the region during the afternoon of July 16. Many of these storms became severe, producing large hail and damaging winds that downed large trees and power lines.
- On July 16, 2000, scattered thunderstorms that produced winds in excess of 55 miles per hour, heavy rainfall, large hail, and frequent lightning moved across Maryland. In Frederick County, quarter-sized hail destroyed a cornfield in Thurmont and a car was hit by lightning, but no one was injured.
- On June 22, 2001, severe storms contained very heavy rainfall, frequent lightning, and occasionally produced high winds and large hail. In Frederick County, nickel-sized hail was reported on Maryland Route 40 west of Frederick. In Frederick, pea-sized hail fell and a wind gust of 50 miles per hour was estimated. Trees were downed by high winds in the Putman Road area 5 miles north-northwest of Frederick. Pea-sized hail was reported in Poolesville. A spotter in Braddock Heights reported 2 inches of rainfall in 20 minutes. At Point of Rocks, the railroad crossing on Maryland Route 28 was flooded. A three-story mansion was struck by lightning and the resulting fire caused $300,000 damage. Another lightning fire in Kemptown caused $20,000 damage. No casualties or fatalities were reported.

Lightning

- On June 7, 2008, a local newspaper reported a lightning-sparked fire on the 2300 block of Ballenger Creek Pike in the unincorporated city of Adamstown. A very warm, humid air mass was entrenched across the mid-Atlantic during the late afternoon and evening hours of June 7. As an upper level disturbance moved across the area, scattered strong to severe thunderstorms developed. Damaging winds brought down some trees and power lines throughout Maryland.
- On June 10, 2008, a local newspaper reported a lightning-sparked basement fire on Kemptown Court in New Market. Cool, drier air behind the front clashed with very warm and moist air

ahead of it, resulting in scattered to numerous strong to severe thunderstorms. Storms that became severe brought down trees and power lines throughout the state.

- On August 21, 1994, lightning struck and burned a historic barn in the City of Frederick at the School for the Deaf. The County incurred a total damage of $500,000.
- On July 28, 1999, a series of thunderstorms swept across north-central Maryland, producing heavy downpours, frequent lightning, and damaging winds in excess of 55 miles per hour. The storms moved through Washington, Frederick, Carroll, and Howard Counties. In Frederick County, trees and power lines were downed onto Maryland Route 180 at the intersection of Mount Zion Road, Main Street in New Market, Maryland Route 75 between Maryland Route 80 and Ed McClain Road, and Maryland Route 144. A concentrated area of tree damage also occurred between Monrovia and Bartholows Road. Monrovia was hit especially hard. One home lost part of its roof when several trees fell onto the structure. A car in the driveway was also damaged by a fallen tree. A nearby 150 year old log home valued at $130,000 was hit by lightning and burned to the ground. The fire department reported delays reaching the structure because of roads blocked by downed trees. In the City of Frederick, 1 house was damaged and 22 intersections were blocked by fallen trees. Approximately 150,000 customers in and around Frederick County lost power as a direct result of the storm. The total property damage was estimated at $130,000.
- On August 7, 2000, scattered thunderstorms moved across central Maryland during the afternoon and early evening. These storms produced winds in excess of 55 miles per hour, frequent lightning, and hail. In the City of Frederick, an apartment complex was hit by lightning. The total property damage during this lightning event (including Howard, Prince George's, and Montgomery Counties) was $750,000.
- In August 2002, several thunderstorms with high winds, large hail, and frequent lightning moved through western and central Maryland. In Frederick County, a 52 year old man was killed by lightning while standing on the back porch of his Frederick home. It was not raining at the time he was struck. A 17 year old swimming pool lifeguard at Fort Detrick was injured when lightning struck nearby. A 36 year old Frederick County man was also injured by lightning in an unknown location. At least 4 homes across the County were damaged by lightning and 2,000 bales of hay were set on fire near Emmitsburg. Wind damage was reported in Park Mills. Marble- to quarter-sized hail fell just south of Frederick for nearly 10 minutes. No fatalities or casualties were reported and there was no damage to crops or property.
- On August 29, 2003, a home caught fire after being struck by lightning. An afternoon thunderstorm produced a lightning bolt that struck a home in Brunswick. The home on East A Street was heavily damaged from the resulting fire and two families were displaced. The damage was estimated at $50,000.

Severe Winter Storms

- From December 18 to 19, 2009, a strong area of low pressure tracked slowly over the Mid-Atlantic, bringing 19 to 23 inches of snow across Frederick County.
- On January 17, 2008, a snowstorm passed through Maryland, resulting in an accumulation of nearly 6 inches of snow and sleet in Frederick County.
- On February 11 and 12, 2006, an historic snowstorm occurred across the mid-Atlantic. Storm total snowfall in Maryland ranged between 8 and 14 inches. A period of thundersnow occurred overnight and early in the morning of February 12 throughout areas of the northern Washington, DC, suburbs and the Baltimore suburbs, where localized snowfall ranged from 14 to 22 inches. There were also numerous reports of downed trees and power lines, causing

significant power outages. Local utility companies reported total power outages of around 300,000 customers in the Washington/Baltimore region. Amtrak reported major delays and cancellations along the northeast rail corridor, which passes through both Baltimore and Washington, DC. Damages were estimated at $230,000.

- On March 26, 1997, a strong surface high pressure area over New England pushed a shallow layer of subfreezing air into the northern tier of Maryland, causing a severe winter storm. Carroll, Frederick, northern Baltimore, and Washington Counties were affected. Total property damage to these counties was estimated at $150,000.
- On January 14, 1999, a strong arctic cold front moved slowly southeast across the Mid-Atlantic region. This front brought a thick layer of sub-freezing air to the lowest levels of the atmosphere, but just off the surface, warmer air moved in. This created ice accumulations of 1.25 to 1.5 inches north and west of a line from Montgomery County to Harford County, including Frederick County. The total damage to Maryland counties was estimated at $3.2 million. No fatalities or casualties were reported.
- On February 14, 2003, a complex storm system produced copious amounts of wintry precipitation across Maryland west of the Chesapeake Bay. Nicknamed the President's Weekend Snowstorm of 2003, this storm will go down in history as the heaviest snowstorm in the Baltimore region since records began in 1870. A total of 28.2 inches of snow was recorded at Baltimore-Washington International Airport. This massive storm took a heavy toll on residents, structures, transportation systems, emergency responders, businesses, livestock, and travelers. A state of emergency was declared by the Governor and people across the state were ordered to stay off the roads during the height of the storm between the morning of the 16th and the morning of the 17th. Roads were covered by deep snow and sleet and were nearly impassable. Main highways were partially cleared by the 18th but it took up to 5 days to reach some secondary and residential roads. In Frederick County, 5 sheds or barns caved-in. Portable classrooms at 4 County schools collapsed. A meeting hall and a tennis court bubble were crushed. A 42 year old man died from a heart attack after shoveling snow in New Market. A 12 year old boy died from carbon monoxide poisoning in a snowbound car in Mount Airy. Property damage incurred by the Maryland counties was approximately $5.2 million. There were 2 fatalities and 10 injuries.
- On December 5, 2003, a winter storm produced 5 to 6 inches of snow across North and Central Maryland. A medical condition rendered a Frederick woman unconscious after she walked outside to check her mailbox and she eventually died of hypothermia. No property or crop damage was reported during this event.

Tornadoes

- On September 17, 2004, three tornadoes touched down in Frederick County. An F1 tornado produced structural damage to several homes near Brunswick. A few structures and outbuildings were destroyed. Other structures sustained roof damage, and trees were downed or stripped. The tornado continued to cause damage to the north along U.S. Route 17 for approximately three miles before lifting at Burkittsville. A second F1 tornado touched down in south-central Frederick County, just east of Adamstown. The storm traveled north and produced minor structural damage. It blew out windows, tore shingles off several roofs, and caused one chimney collapse. The tornado also uprooted and sheared several large softwood and hardwood trees. Finally, an F2 tornado touched down in far northwest Frederick County, on the northwest edge of Catoctin Mountain Park. A thickly forested stand of hardwoods was snapped off above their bases. Total damage from the tornadoes was $255,000.

- On July 31, 1978, a tornado was visible in Frederick County. The exact location was unknown. Property damage was estimated at $25,000. No fatalities or injuries were reported.
- On July 19, 1996, a supercell thunderstorm produced an F2 tornado in Yarrowsburg (Washington County) and dropped a second tornado in Rosemont. The tornado first touched down in Rosemont, damaging numerous trees as it crossed Maryland Route 17 and moved into Brunswick. A service station's roof was partially damaged by a fallen tree. Many of the homes in Brunswick were protected by the trees and the steep sloping terrain towards the Potomac. The total property damage was estimated at $80,000 and total crop damage was estimated at $50,000.
- On August 14, 1999, an area of thunderstorms moved across much of Maryland, producing damaging wind, frequent lightning, and brief heavy downpours. The thunderstorm complex intensified rapidly as it moved into Frederick County. The northwest side of the City of Frederick took the brunt of the storm. As the storm reached the Abbington Farms area, a tornado developed. The tornado was F1 strength with winds between 75 and 112 mph and ranged from 50 to 200 yards wide as it traveled east for 3 miles. The twister did extensive damage to trees as it moved through the communities of Eastview, Walnut Springs, Shookstown, and Fort Detrick. Some trees fell onto cars and houses, and a few homes under construction were damaged. One home under construction in Walnut Ridge was torn to pieces by the tornado and the debris turned into airborne missiles that heavily damaged two finished homes nearby. Two homes in the Eastview subdivision were condemned after trees fell onto the structures. A chimney was blown off a Willowdale Drive home. Yellow Springs Road had to be closed for several hours until power and telephone poles blocking the road could be cleared. A metal storage building on Rosemont Avenue was crumpled. Part of the roof of the Food Lion grocery store on Rosemont Avenue was torn off and thrown toward the gates of Fort Detrick. The store suffered water damage and the loss of frozen foods and perishables from the resulting power outage. Next, the storm moved across Fort Detrick, causing $260,000 in damage. The twister moved onto the main post where it uprooted trees, downed power lines, and blew off parts of buildings. The headquarters building and post chapel lost part of their roofs. Nearly 30 cars along Rocky Springs Road and near post housing were damaged by downed trees and debris. In addition, the central portion of Frederick was hit by destructive straight line winds estimated between 60 and 70 miles per hour. Thirty Bradford pear trees were downed on Heather Ridge Drive. Sixteen city streets were closed by fallen trees. A 1 mile stretch of Maryland Route 40 west of the Golden Mile had to be closed for an hour to clear fallen trees. A glider valued at $11,000 was ripped from its mooring at the airport and totaled. The storm downed a total of 300 trees across Frederick and resulted in outages for 8,000 power customers. High winds also downed trees in Brunswick, leaving 100 customers without power. The total damage to property was $800,000.
- On June 14, 2004, unconfirmed reports of funnel clouds and tornadoes were received by the National Weather Service Office in Sterling. Several areas across northern Maryland reported wind damage mainly due to downed trees and powerlines. Areas of damage included the region between Thurmont and Libertytown. The tornado was rated F1 with estimated winds of 75 mph. The initial tornado touchdown occurred 1.5 miles north of Woodsboro along Maryland Route 194 near a cement plant. The tornado tracked southeast mostly across farmland and wooded areas, uprooting and toppling trees along its path.

Tropical Storm/Hurricanes

- On September 6, 2008, Tropical Storm Hanna entered Maryland resulting in heavy rain and severe winds in Frederick County. Tropical Storm Hanna tracked up the Mid-Atlantic coast on the 6th with maximum sustained winds around 50 mph. Hanna originally made landfall near

the border of North and South Carolina around 3:20 a.m. on the 6th. Hanna tracked across eastern North Carolina during the early afternoon hours before turning northeast across southeastern Virginia later in the afternoon. Hanna eventually tracked across the Chesapeake Bay and into Delaware during the evening hours. With Hanna's track to the east, the strongest winds were also confined to Frederick County's east; however, Hanna was still responsible for heavy rain along with tropical storm force winds across Maryland. Rainfall amounts totaled 4 to 8 inches in many locations. Numerous roads were closed throughout Maryland due to flash flooding. Tropical storm force winds were responsible for downed trees and power lines across Maryland as well. The worst conditions occurred during the late morning and afternoon hours as the storm passed by just to the east. A large tree was down between U.S. Route 15 (Southbound) and Point of Rocks Road.

- During Agnes in June 1972, two houses in the City of Frederick were flooded by an inadequate drainage ditch. The city spent more than $400,000 to purchase and demolish the structures, and clear asbestos and spilled heating oil from the properties.
- Additional detail on events captured under *Flooding* section.

Hydrological Hazards

Drought

- Much of 2007 was extremely dry across Maryland as well as in Frederick County. In early October 2007, rainfall deficits across the County reached nearly 10 inches for the year. A strong ridge of high pressure was anchored over the Eastern Seaboard throughout much of the year, resulting in little moisture from cold fronts. Most of the County was classified under extreme drought conditions by the United States Drought Monitor. Many towns, cities, and counties across Maryland enacted mandatory and voluntary water restrictions. Area streams and rivers experienced all-time record low water levels, especially in the late summer and early fall due to the extreme hydrological drought. Many farmers in the county had very poor yields in crop production due to the extreme dryness.
- The period between September of 2001 and August of 2002 was the second driest 12 months in Maryland history. By August of 2002, groundwater levels had reached record lows. Along with several other eastern states, Maryland was in a state of "extreme drought" as defined by the United States Drought Monitor, characterized by major crop/pasture losses, extreme fire danger, and widespread water shortages. Above normal rainfall in October of 2002 helped alleviate drought conditions and reduced drought conditions to abnormally dry. By February of 2003, water restrictions were lifted in most of the state, including Frederick County (umd.edu).
- July 1997 was a very dry month with a 7 day heat wave that exacerbated drought-like conditions across much of the fertile farmland of Maryland. The weather in July proved disastrous for many crop yields, including corn, hay, alfalfa, and soybeans. Agricultural states of emergency were declared in many areas west of the Chesapeake Bay. Hardest-hit counties included Carroll, Frederick, Howard, Montgomery, and Washington. Some of the more impressive damage estimates included: in Frederick County nearly $9 million in corn, an approximate 90 percent loss; an additional $5.5 million in corn for silage and soybeans, a 60 percent loss. The total crop damage to the 12 county region in Maryland was estimated at $43.7 million.
- November 1998 was the fifth month in a row that drought conditions were seen across central and northern Maryland. Only 1.13 inches of rain fell at the Baltimore/Washington International Airport in Anne Arundel County during the month of November, 2.07 inches below normal. Other monthly rainfall totals from affected counties included 0.6 inches in Washington, 0.7 in

Howard, 0.9 in Frederick, 1.0 in Charles, 1.1 in Carroll and Anne Arundel, and 1.2 in Montgomery and Prince George's. Water levels and reserves were greatly affected by the persistent drought. The total crop damage incurred by 13 counties in Maryland, including Frederick County, was approximately $20 million.

- Between September 1998 and August 1999, precipitation was a staggering 12 to 16 inches below average. In August, 6.14 inches of rain fell at Baltimore/Washington International Airport, 2.22 inches above normal. Additional August rainfall totals included Allegany County at 2.5 inches, Washington County at 2.3 inches, Frederick County at 3.1 inches, Prince George's County at 5.3 inches, Carroll County at 4.7 inches, Anne Arundel at 6.6 inches, Northern Baltimore County at 5.4 inches, Howard County at 4.3 inches, Montgomery County at 4.6 inches, Charles and Calvert Counties at 5.5 inches, and St. Mary's County at 5.8 inches. The lack of rainfall through the third week of August continued to affect water levels along the Potomac River and the Chesapeake Bay. Nineteen Maryland counties were declared federal drought disaster areas. The worst agricultural drought in Maryland continued to devastate farmers. Approximately 55 percent of pasture land, 45 percent of corn, 39 percent of sorghum, 29 percent of tobacco, and 34 percent of soybeans across the state were reported in poor or very poor condition; 42 percent of topsoil and 84 percent of subsoil were reported as short or very short of moisture. Frederick County lost 90 percent of the corn and soybean crop, losing $9 million revenues. Crop damage for several Maryland counties totaled to $30 million.
- During the summer of 2002, drought gripped the State of Maryland. The ground and reservoir water supply in Frederick County was low. By September 2002, the area was being strangled by the worst drought in more than 30 years. The first nine months of 2002 were dangerously dry, with 25 inches of rain recorded at Dulles International Airport during that time (average for that time period is 32 inches).

Flash Floods and Flooding

- On June 27, 2006, waves of low pressure rode along a stationary front parked just to the west of the region. Clusters of strong thunderstorms trained over the county in a tropical air mass. Reports of 4 to 7 inches of rain in a short amount of time turned normally small streams into raging torrents of water. Three people died from drowning in the bed of a pickup truck driving through flooded roads east of Myersville along Middle Creek. Two teenagers died near Little Pipe Creek. It is believed the teenagers were swept away while swimming in the raging creek. MARC Commuter Rail experienced numerous disruptions with underground tunnels being filled up with water. Numerous roads were closed across the county due to high water or mud slides. Damage from the flash flooding was estimated at $500,000.
- On September 20, 2003, 2 to 4 inches of rain, a result of Hurricane Isabel, fell across central and western Maryland. This was not enough to cause flash flooding but added to previous rains. Three homes sustained moderate to major damage from flooding and 2 homes experienced minor to moderate damage. The flood waters also closed down a section of the C&O canal. The Monocacy River remained well below flood stage in Frederick.A state trooper was injured when a tree fell on his car in the storm and another was injured when a tree fell on him. Two homes had some damage and there were 40 road closures from trees falling on them. Approximately 28,892 customers lost power in the County. Damages were estimated over $100,000.
- On June 14, 1972, Hurricane Agnes began as a tropical disturbance off the coast of Mexico; by June 19, Agnes had become a hurricane. The storm made initial landfall along the Florida panhandle and made her way up the Atlantic Coast. The most impressive aspect of the hurricane was the widespread nature of its floods, resulting in extremely rare floods on major

rivers and streams. The flood recurrence frequency in many locations exceeded 100 years, most notably on the Susquehanna River downstream of Waverly, New York, and on the Potomac River, downstream from Point of Rocks, Maryland. The Monocacy River in Frederick rose from a height of 30 feet to 35.9 feet after Agnes. Hurricane Agnes was the costliest natural disaster in the United States at that time. Damage was estimated at $3.1 billion and 117 deaths were reported. In Maryland, the damage was estimated at $110 million and 19 deaths were reported.

- On January 19, 1996, snowmelt combined with 1 to 3 inches of rain to produce heavy river flooding in Allegany, Montgomery, Washington, and Frederick Counties. The flooding was the worst in the region since 1985. Almost all dwellings in the town of Point of Rocks were damaged by floodwaters in some way. There were several water and sewage plant failures. Water line breaks in La Vale and failures at Sharpsburg and Hagerstown forced residents to boil water for 3 to 5 days (thousands of others were without water for 1 to 2 days). The plant in Brunswick was shut down for 1 to 3 days due to flood waters and high turbidity. Three counties, Washington, Allegany, and Frederick in central Maryland were declared under a federal disaster declaration. Total property damage in the area was estimated at $60 million. No fatalities or injuries were reported.
- On June 19, 1996, the northern part of the County experienced a major flood. There was one fatality and approximately $5 million of property damage.
- On September 6, 1996, flooding was experienced throughout the County. No casualties or injuries were reported. Property damage was $75,000 and crop damage was $10,000.
- On August 1, 2000, scattered thunderstorms produced very heavy rainfall, gusty winds, and frequent lightning. In Frederick County, the chimney of a two-story home in Jefferson was struck by lightning. A fire resulted that heavily damaged the structure. A heavy downpour sent Martin's Creek out of its banks in Brunswick. Rushing water from the creek inundated nearby buildings. A Brunswick City building made of cinder blocks had the rear and part of a side wall washed away. Cars, trucks, and other equipment stored inside were also damaged. Some culvert pipes were washed out and a foot bridge and a fence were washed away. A home across the street from the creek also reported flood damage to appliances. Property damage to the County was approximately $100,000. No fatalities or injuries were reported.
- On September 18, 2003, Hurricane Isabel made landfall on the North Carolina Coast. The high wind gusts up to 70 mph came with bands of showers down to the surface, causing streaks of damage that sometimes appeared as though a tornado had moved through instead of a strong narrow ribbon of wind. Wind damage to structures was limited but wind damage to trees in the area was extensive and widespread. Soil moisture was high from previous rains, making it easier for trees to uproot. The trees were also still in full canopy, which acted like a sail to catch the wind. Trees fell on electrical and utility wires, taking out power and phone lines. Trees fell on roads, cars, and homes. In Frederick County, a state trooper was injured when a tree fell on his car in the storm and another was injured when a tree fell on him. Two homes had some damage and there were 40 road closures from fallen trees. Approximately 29,000 customers lost power in Frederick County due to this flooding event. The region incurred property damage of approximately $130,000. No fatalities were reported.

Geologic Hazards

Karst/Sinkholes

- In June 2008, a large sinkhole formed on Interstate 70 near Patrick Street and Market Street, closing the highway, and another formed near South Street on Interstate 70. One particular

sinkhole that appeared in this area was so large that the depth of the hole was never actually determined. The Maryland State Highway Administration placed 60 feet of rope down the hole to determine its depth but was unable to identify solid rock bed at that depth.

- A sinkhole closed the westbound side of Interstate 70 just to the east of Frederick on April 24, 2008. The sinkhole was 20 feet across and 35 feet deep. It was found by a Maryland State Trooper traveling westbound on Interstate 70 who reported it to the Maryland State Highway Administration. There were no injuries.
- In September 2003, heavy rains that followed Hurricane Isabel caused a 110 foot long, 35 foot deep sinkhole along Interstate 70 at the interchange with South Street. This caused temporary closure of South Street and the MARC rail line, knocking out power and putting backpressure on sewage treatment plants.
- One of the largest sinkholes in Frederick County occurred on New Design Road in June 2003. The sinkhole, 12 feet deep and 30 feet in diameter, opened across both northbound lanes and cost nearly $2 million to repair. DPW is currently developing a sinkhole inspection program to map areas of sinkhole incidence and to establish a regular review program.
- Another sinkhole formed in a local farmer's field in March 2003. Others appeared at the East Gate Shopping Center and in Sagner Park in April and September 2003, respectively. In general, they were 7 to 8 feet deep and 4 to 5 feet in diameter.
- In September 2002, 12 sinkholes formed after Tropical Storm Hanna dropped several inches of rain on the county. The sinkholes were found near Maryland Route 85 in the southern portion of the county; the largest was 20 feet in diameter.

Vulnerability Assessment

Table A.1 in this section lists the critical facilities in the county that fall into one or more hazard zones. The table begins with an explanation of the codes found for each hazard.

Critical Facility Hazard Analysis Results

Table A.1 Critical Facilities Located Within Hazard Zones

Flood Zone

- X-unshaded = Facility located in area of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2 percent annual chance flood (500 year flood)
- X-shaded = Facility located in area of moderate flood hazard between the limits of the base flood (100 year) and the 0.2 percent annual chance (500 year) flood
- A = Facility located in area subject to inundation by the 1 percent annual chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown.
- AE = Facility located in area subject to inundation by the 1 percent annual chance flood event determined by detailed methods.

Floodway

- Y = Facility located in mapped floodway
- N = Facility not located in mapped floodway

Wildfire/Wildland Urban Interface

- Interface = Facility located in developed areas that abut wildland vegetation
- Intermix = Facility located in an area where structures and wildland vegetation intermingle
- Other = Facility not located in wildfire interface or intermix

Karst

- Short_1 = Facility located in area where fissures, tubes, and caves are generally less than 1,000 feet (300 meters) long; 50 feet (15 meters) or less vertical extent; in metamorphosed limestone, dolomite, and marble
- Short_3 = Facility located in area where fissures, tubes, and caves are generally less than 1,000 feet (300 meters) long; 50 feet (15 meters) or less vertical extent; in moderately- to steeply-dipping beds of carbonate rock.
- None = Facility not located within mapped karst area

Landslide

- Combo-hi = Facility located in area of high susceptibility and moderate incidence of landslide occurrence (1.5 percent to 15 percent of area involved) (based on USGS maps)
- Low = Facility located in area of low incidence (less than 1.5 percent of area involved) (based on USGS maps)
- Sus_mod = Facility located in area of moderate susceptibility/low incidence

Earthquake

- 6 = Facility located in area where there is a 2 percent probability that the peak ground acceleration (PGA) will exceed 6 percent in a 50 year period

Dam Inundation

- Fish Creek Dam inundation area = Facility located in this dam inundation area
- Lake Linganore inundation area = Facility located in this dam inundation area
- Hunting Creek Dam Inundation Area = Facility located in this dam inundation area
- None – Facility not located in a dam inundation area

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Brunswick									
Fire/EMS	Brunswick Volunteer Ambulance Company	204 W Potomac Street	X-unshaded	N	Other	none	combo-hi	6	none
Fire/EMS	Brunswick Volunteer Fire Company	1500 Volunteer Drive	X-unshaded	N	Other	none	combo-hi	6	none
Law Enforcement	Brunswick Police Station	20 East A Street	X-unshaded	N	Other	none	combo-hi	6	none
Library	Brunswick Library	915 N Maple Avenue	X-unshaded	N	Other	none	combo-hi	6	none
Post Office	Brunswick Post Office	315 Brunswick Street, Brunswick, MD 21716	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility	Brunswick City Hall	1 W Potomac Street	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility	Brunswick Water Storage	600 Petersville Avenue	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility	Brunswick Senior Center	12 East A Street, Brunswick MD, 21716	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Brunswick Elementary	400 Central Avenue	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Brunswick High	101 Cummings Avenue	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Brunswick Middle	301 Cummings Avenue	X-unshaded	N	Other	none	combo-hi	6	none
Radio Tower	Brunswick Radio Tower	214 13th Avenue	X-unshaded	N	Other	none	combo-hi	6	none
Transportation	Brunswick MARC Station	100 S. Maple Avenue	A	N	Other	none	combo-hi	6	none
WTP/WWTP	Sewer	S Maple Avenue	A	N	Other	none	combo-hi	6	none
WTP/WWTP	Water Facility	East Potomac Street	X-unshaded	N	Other	none	combo-hi	6	none
Burkittsville									
Post Office	Burkittsville Post Office	8 E Main Street, Burkittsville, MD 21718	X-unshaded	N	Interface	none	combo-hi	6	none
Public Facility	Town Hall of Burkittsville	12 Main Street	X-unshaded	N	Interface	none	combo-hi	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Emmitsburg									
Fire/EMS	Vigilant Hose Company	25 W Main Street	X-unshaded	N	Interface	none	combo-hi	6	none
Fire/EMS	Emmitsburg Ambulance Company	1 Creamery Road	X-unshaded	N	Other	none	combo-hi	6	none
Law Enforcement	Emmitsburg Police Department	22 East Main Street, Emmitsburg, 21727-9210	X-unshaded	N	Other	none	combo-hi	6	none
Library	Emmitsburg Community Center	300 S Seton Avenue	X-unshaded	N	Other	none	combo-hi	6	none
Nursing and Care Facility	St Joseph's Ministries	331 South Seton Avenue, Emmitsburg, 21727	X-unshaded	N	Other	none	combo-hi	6	none
Post Office	Emmitsburg Post Office	305 S Seton Avenue, Emmitsburg, 21727	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility	Town Hall of Emmitsburg	300A S. Seton Avenue, Emmitsburg, 21727	X-unshaded	N	Interface	none	combo-hi	6	none
Public School	Emmitsburg Elementary	300 S. Seton Avenue	X-unshaded	N	Other	none	combo-hi	6	none
Frederick City									
Colleges and Universities	Frederick Community College	7932 Opossumtown Pike, Frederick, 21702	X-unshaded	N	Other	none	combo-hi	6	none
Fire/EMS	Fort Detrick	1419 Sultan Street	X-unshaded	N	Other	none	combo-hi	6	none
Fire/EMS	Citizens Truck Company	9 S Court Street	X-unshaded	N	Other	short_1	low	6	none
Fire/EMS	United Steam Fire Engine Company	87 S Market Street	X-unshaded	N	Other	short_1	low	6	none
Fire/EMS	Junior Fire Company	533 N Market Street	X-unshaded	N	Other	short_1	combo-hi	6	none
Fire/EMS	Independent Hose Company	310 Baughmanæs Lane, Frederick, MD 21701	AE	Y	Other	none	combo-hi	6	none
Fire/EMS	Frederick County Advanced Life Support	340 Montevue Lane, Frederick, MD 21702	X-unshaded	N	Other	none	combo-hi	6	none
Fire/EMS Support	DFRS LOGISTICS	300A Scholl's Lane, Frederick, MD 21701	X-unshaded	N	Other	short_1	low	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Law Enforcement	Frederick Police Station	100 West Patrick Street	X-unshaded	N	Other	short_1	low	6	none
Law Enforcement	Frederick City Police South Court St	6 South Court Street, Frederick, MD 21701	X-unshaded	N	Other	short_1	low	6	none
Law Enforcement	Law Enforcement Center	110 Airport Drive E, Frederick MD 21701	X-unshaded	N	Other	short_1	low	6	none
Library	C Burr Artz Library	110 E Patrick Street	X-unshaded	N	Other	short_1	low	6	none
Nursing and Care Facility	Heartfields At Frederick	1820 Latham Drive	X-unshaded	N	Other	none	low	6	none
Nursing and Care Facility	Homewood At Crumland Farms	7407 Willow Road	X-unshaded	N	Other	none	combo-hi	6	none
Nursing and Care Facility	Montevue Assisted Living	1910 Rosemont Avenue	X-unshaded	N	Other	none	combo-hi	6	none
Nursing and Care Facility	Record Street Home - Home For The Aged	115 Record Street	X-unshaded	N	Other	short_1	low	6	none
Nursing and Care Facility	Somerford House - Frederick	2100 Whittier Drive	X-unshaded	N	Interface	none	combo-hi	6	none
Nursing and Care Facility	Sunrise Of Frederick	990 Waterford Drive	X-unshaded	N	Other	short_1	combo-hi	6	none
Nursing and Care Facility	Tranquillity At Fredericktowne	6441 Jefferson Pike	X-unshaded	N	Other	short_1	combo-hi	6	none
Nursing and Care Facility	Warm Heart Family Assistance Living II	752 Dogwood Court	X-unshaded	N	Other	short_1	low	6	none
Nursing and Care Facility	Rose Hill Manor	1611 North Market Street, Frederick MD 21701	X-unshaded	N	Other	none	combo-hi	6	none
Nursing and Care Facility	Frederick Memorial Hospital	400 West Seventh Street, Frederick, MD 21701	X-unshaded	N	Other	short_1	combo-hi	6	none
Nursing and Care Facility	Citizens Care And Rehabilitation Center Of Frederi	1920 Rosemont Avenue, Frederick, 21702	X-unshaded	N	Other	none	combo-hi	6	none
Nursing and Care Facility	College View Center	700 Toll House Avenue, Frederick, 21701	X-unshaded	N	Other	short_1	combo-hi	6	none
Nursing and Care Facility	Golden Living Center - Frederick	30 North Place, Frederick, 21701	X-unshaded	N	Other	short_1	combo-hi	6	none
Nursing and Care Facility	Northampton Manor	200 East 16th Street, Frederick, 21701	X-unshaded	N	Other	short_1	combo-hi	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Post Office	Frederick Post Office	201 E Patrick Street, Frederick, MD 21701	X-unshaded	N	Other	short_1	low	6	none
Post Office	Frederick Post Office	1301 W 7th Street, Frederick, MD 21702	X-unshaded	N	Other	short_1	combo-hi	6	none
Post Office	Frederick Post Office	401 Rosemont Avenue, Frederick, MD 21701	X-unshaded	N	Other	short_1	combo-hi	6	none
Post Office	Frederick Post Office	467 W Patrick Street, Frederick, MD 21701	X-unshaded	N	Other	short_1	combo-hi	6	none
Public Facility	County Courthouse	122 W Patrick Street	X-unshaded	N	Other	short_1	low	6	none
Public Facility	Board Of Education	191 S East Street	X-unshaded	N	Other	short_1	low	6	none
Public Facility	Frederick City Hall	101 N Court Street	X-unshaded	N	Other	short_1	low	6	none
Public Facility	Frederick City Government Offices	154 W Patrick Street	X-unshaded	N	Other	short_1	low	6	none
Public Facility	Frederick City DPW		X-unshaded	N	Other	short_1	low	6	none
Public Facility	300 Scholls Lane Sub Abuse	300 Scholl's Lane, Frederick MD 21701	X-unshaded	N	Other	short_1	combo-hi	6	none
Public Facility	Animal Control	1832 Rosemont Avenue, Frederick, MD 21702	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility	Animal Health Lab	1840 Rosemont Avenue, Frederick, MD 21702	X-shaded	N	Other	none	combo-hi	6	none
Public Facility	Family Partnership	8420 Gas House Pike Suite EE, Frederick MD 21701	X-unshaded	N	Other	none	low	6	none
Public Facility	Frederick Senior Center	1440 Taney Avenue, Frederick MD 21702	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility	Head Start Building	401 Sagner Avenue, Frederick MD 21701	X-shaded	N	Other	short_1	low	6	none
Public Facility	Health Department	350 Montevue Lane, Frederick, MD 21702	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility	Scott Key Center	1050 Rocky Springs Road, Frederick MD 21702	X-unshaded	N	Other	none	combo-hi	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Public Facility	Tourism	19 East Church Street	X-unshaded	N	Other	short_1	low	6	none
Public Facility	Social Services	100 W All Saints Street, Frederick MD 21701	X-unshaded	N	Other	short_1	low	6	none
Public Facility - Govt Admin	30 N Market Street	30 N. Market Street, Frederick MD 21701	X-unshaded	N	Other	short_1	low	6	none
Public Facility - Govt Admin	Courthouse Complex	100 W. Patrick Street, Frederick MD 21701	X-unshaded	N	Other	short_1	low	6	none
Public Facility - Govt Admin	118 N Market Offices	118 N. Market Street, Frederick MD 21701	X-unshaded	N	Other	short_1	low	6	none
Public Facility - Govt Admin	Dhia Building	332 Montevue Lane, Frederick MD 21702	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility - Govt Admin	Election Warehouse	341 Montevue Lane, Frederick MD 21702	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility - Govt Admin	Extension Service	330 Montevue Lane, Frederick MD 21702	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility - Govt Admin	Highway Fleet Services Building	331 Montevue Lane, Frederick MD 21702	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility - Govt Admin	Bourne Building	355 Montevue Lane, Frederick MD 21702	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility - Govt Admin	Transit	1040 Rocky Springs Road, Frederick MD 21702	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility - Govt Admin	Winchester Hall	12 E. Church Street, Frederick MD 21701	X-unshaded	N	Other	short_1	low	6	none
Public Facility - Maintenance	Maintenance Parks Shop	430 Pine Avenue, Frederick MD 21701	X-unshaded	N	Other	short_1	low	6	none
Public School	Whittier Elementary	2400 Whittier Drive	X-unshaded	N	Interface	none	combo-hi	6	none
Public School	Monocacy Elementary	7421 Hayward Road	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Parkway Elementary	300 Carroll Parkway	X-unshaded	N	Other	short_1	combo-hi	6	none
Public School	Waverley Elementary	201 Waverly Drive	X-unshaded	N	Interface	none	combo-hi	6	none
Public School	North Frederick Elementary	1001 Motter Avenue	X-unshaded	N	Other	short_1	combo-hi	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Public School	Hillcrest Elementary	1285 Hillcrest Drive	X-unshaded	N	Other	short_1	combo-hi	6	none
Public School	Frederick High	650 Carroll Parkway	X-unshaded	N	Other	short_1	combo-hi	6	none
Public School	West Frederick Middle	515 West Patrick Street	X-unshaded	N	Other	short_1	combo-hi	6	none
Public School	Governor Thomas Johnson High	1501 Market Street	X-unshaded	N	Other	short_1	combo-hi	6	none
Public School	Governor Thomas Johnson Middle	1799 Schifferstadt Boulevard	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Monocacy Middle	8009 O'Possumtown Pike	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Heather Ridge (High)	1445 Taney Avenue	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Career & Technology Center	7922 O'Possumtown Pike	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Rock Creek School	191 Waverly Drive	X-unshaded	N	Interface	none	combo-hi	6	none
Public Schools	Lincoln Elementary A	250 Madison Street	X-unshaded	N	Other	short_1	low	6	none
Public Schools	Lincoln Elementary B	200 Madison Street	X-unshaded	N	Other	short_1	low	6	none
Radio Tower	LEC Master/Prime Radio Tower		X-unshaded	N	Other	short_1	low	6	none
Radio Tower	Hill St Radio Tower		X-unshaded	N	Other	short_1	combo-hi	6	none
Radio Tower	EOC Radio Tower		X-unshaded	N	Other	none	combo-hi	6	none
Radio Tower	Vernon Ave Radio Tower		X-unshaded	N	Other	short_1	low	6	none
Transportation	Frederick Municipal Airport		X-unshaded	N	Other	short_1	low	6	none
Transportation	Frederick MARC Station	100 S. East Street	X-unshaded	N	Other	short_1	low	6	none
WTP	Monocacy Water Treatment Plant	N Market Street	X-unshaded	N	Other	none	combo-hi	6	none
WTP	Fort Detrick Water Treatment Plant	N Market Street	X-unshaded	N	Other	none	combo-hi	6	none
WWTP	Fort Detrick Waste Water treatment Plant	N Market Street	X-unshaded	N	Other	none	low	6	none
WWTP	Sewer Waste Water Treatment Plant		X-unshaded	N	Other	none	combo-hi	6	none
WWTP	Frederick City Waste Water treatment Plant	Treatment Plant Road	X-unshaded	N	Other	short_1	low	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Middletown									
Fire/EMS	Middletown Volunteer Fire Company	13 S Church Street	X-unshaded	N	Other	none	combo-hi	6	none
Library	Middletown Branch Library	Prospect Street	X-unshaded	N	Other	none	combo-hi	6	none
Post Office	Middletown Post Office	7227 Hollow Road	X-unshaded	N	Interface	none	combo-hi	6	none
Public Facility	Middletown Town Hall	31 W Main Street	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Middletown Elementary	201 Green Street	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Middletown Middle	100 Schoolhouse Drive	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Middletown High	200 Schoolhouse Drive	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Middletown Primary	403 Franklin Street	A	N	Other	none	combo-hi	6	none
WTP/WWTP	West WWTP Middletown Sewers	Ivy Hill Lane	A	N	Other	none	combo-hi	6	none
Mount Airy									
Public School	Twin Ridge Elementary	1106 Leafy Hollow Circle	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Water Facility - Water Treatment Plant	1302 Park Ridge Dr	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Water Facility - Water Treatment Plant	801 Prospect Rd	X-unshaded	N	Other	none	low	6	none
Myersville									
Fire/EMS	Myersville Volunteer Fire Company	301 Main Street, P.O. Box 95, Myersville, MD 21773	X-unshaded	N	Interface	none	combo-hi	6	none
Post Office	Myersville Post Office	1 Wolfsville Road, Myersville, MD 21773	X-unshaded	N	Interface	none	combo-hi	6	none
Public Facility	Myersville Town Hall		X-unshaded	N	Interface	none	combo-hi	6	none
Public School	Myersville Elementary	429 Main Street	X-unshaded	N	Interface	none	combo-hi	6	none
WTP/WWTP	Myersville WTP	Milt Summers Road	X-unshaded	N	Other	none	combo-hi	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
WTP/WWTP	Myersville Sanitary	Easterday Road	X-unshaded	N	Other	none	combo-hi	6	none
New Market									
Fire/EMS	New Market Volunteer Fire/ Rescue Company	76 West Main Street, P.O. Box 925, New Market, MD 21774	X-unshaded	N	Other	none	low	6	none
Post Office	New Market Post Office	168 W Main Street, New Market, MD 21774	X-unshaded	N	Other	none	low	6	none
Public Facility	New Market Town Hall	W Main Street	X-unshaded	N	Other	none	low	6	none
Public School	New Market Elementary	93 West Main Street	X-unshaded	N	Other	none	low	6	none
Public School	Deer Crossing Elementary	10601 Finn Drive	X-unshaded	N	Other	none	low	6	none
Public School	New Market Middle	125 West Main Street	X-unshaded	N	Other	none	low	6	none
Thurmont									
Fire/EMS	Guardian Hose Company	21 North Church Street, Thurmont, MD 21788	X-unshaded	N	Interface	none	combo-hi	6	none
Fire/EMS	Thurmont Community Ambulance Service	27 North Church Street, Thurmont, MD 21788	X-unshaded	N	Interface	none	combo-hi	6	none
Fire/EMS	Graceham Vol Fire Company		X-unshaded	N	Intermix	none	combo-hi	6	none
Fire/EMS	Lewistown Dist. Vol Fire Dept.		X-unshaded	N	Interface	none	combo-hi	6	none
Law Enforcement	Thurmont Police Station	800 East Main Street	X-unshaded	N	Other	none	combo-hi	6	none
Library	Thurmont Regional Library	76 Moser Road	X-unshaded	N	Intermix	none	combo-hi	6	Hunting Creek Dam Inundation Area
Other	Thurmont Senior Center	806 East Main Street, Thurmont, MD 21788	X-unshaded	N	Other	none	combo-hi	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Post Office	Thurmont Post Office	110 Water Street, Thurmont, MD 21788	X-unshaded	N	Interface	none	combo-hi	6	none
Public Facility	Thurmont Town Hall	10 Frederick Road	X-unshaded	N	Interface	none	combo-hi	6	none
Public School	Thurmont Elementary	805 East Main Street	X-unshaded	N	Interface	none	combo-hi	6	none
Public School	Thurmont Primary	7989 Rocky Ridge Road	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Thurmont Middle	408 East Main Street	X-unshaded	N	Interface	none	combo-hi	6	none
Public School	Catoctin High	14745 Sabillasville Road	X-unshaded	N	Other	none	combo-hi	6	
WTP/WWTP	Sewer		X-unshaded	N	Interface	none	combo-hi	6	
WTP/WWTP	Thurmont WWTP	96 E Moser Road	A	N	Interface	none	combo-hi	6	Hunting Creek Dam Inundation Area
Unincorporated									
Colleges and Universities	Mount Saint Mary's University	16300 Old Emmitsburg Road	X-unshaded	N	Other	none	combo-hi	6	none
Fire/EMS	Spring Ridge Fire Station	6061 Spring Ridge Parkway	X-unshaded	N	Other	short_1	low	6	none
Fire/EMS	Rocky Ridge Volunteer Fire Company	13257 Motters Station Road	X-unshaded	N	Other	none	combo-hi	6	none
Fire/EMS	Carroll Manor Volunteer Fire Company	2795 Adams Street, Adamstown, MD 21710	X-unshaded	N	Other	short_1	low	6	none
Fire/EMS	Libertytown Volunteer Fire Company	12027 South Street	X-unshaded	N	Other	none	low	6	none
Fire/EMS	Graceham Volunteer Fire Company	14026 Graceham Road, P.O. Box 181, Thurmont, MD 21788	X-unshaded	N	Intermix	none	combo-hi	6	none
Fire/EMS	Jefferson Volunteer Fire Company	4603a Lander Road	X-unshaded	N	Interface	none	combo-hi	6	none
Fire/EMS	Wolfsville Volunteer Fire Company	12464 Wolfsville Road, Myersville, MD 21773	X-unshaded	N	Interface	short_3	combo-hi	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Fire/EMS	Lewistown Dist Volunteer Fire Dept.	11101 Hessong Bridge Road, Frederick, MD 21701	X-unshaded	N	Interface	none	combo-hi	6	none
Fire/EMS	Urbana Volunteer Fire & Rescue Company	3602 Urbana Pike, Frederick, MD 21704	X-unshaded	N	Other	none	low	6	none
Fire/EMS	Green Valley/ New Market	3939 Green Valley Road, Monrovia, MD 21770	X-unshaded	N	Other	none	low	6	none
Fire/EMS	Point of Rocks/ Carroll Manor	1809 Ballenger Creek Pike, Point Of Rocks, MD 21777	X-unshaded	N	Intermix	none	combo-hi	6	none
Fire/EMS	Westview/ United Fire Company	5525 New Design Road, Frederick, MD 21703	X-unshaded	N	Other	short_1	low	6	none
Fire/EMS	New Midway Volunteer Fire Company	12019 Woodsboro Pike	X-unshaded	N	Other	none	combo-hi	6	none
Fire/EMS	Braddock Heights Volunteer Fire Company	6715 Jefferson Boulevard., P.O. Box 320, Braddock Heights, MD 21725	X-unshaded	N	Intermix	none	combo-hi	6	none
Law Enforcement	Adult Detention Center	7300 Marcies Choice Lane	X-unshaded	N	Other	short_1	low	6	none
Law Enforcement	Frederick City Police Plant Rd	6424 Plant Road	X-unshaded	N	Other	short_1	low	6	Lake Linganore inundation area
Library	Urbana Library Comm Center	9020 Amelung Street	X-unshaded	N	Other	none	low	6	none
Library	Edward F Fry library	1635 Ballenger Creek Pike	X-unshaded	N	Other	none	combo-hi	6	none
Nursing and Care Facility	Bethany Living II	5135 Charlington Court	X-unshaded	N	Other	short_1	low	6	none
Nursing and Care Facility	Blossom Place At Edenton	5901 Genesis Lane	X-unshaded	N	Other	short_1	combo-hi	6	none
Nursing and Care Facility	Buckinghams Choice, Inc	3200 Baker Circle	X-unshaded	N	Other	none	low	6	none
Nursing and Care Facility	Country Meadows Of Frederick	5955 Quinn Orchard Drive	X-unshaded	N	Other	short_1	low	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Nursing and Care Facility	Cozy Care	12803 Boxwood Court	X-unshaded	N	Other	none	low	6	none
Nursing and Care Facility	Devotion Assisted Living Llc	8531 Inspiration Avenue	X-unshaded	N	Other	none	low	6	none
Nursing and Care Facility	Fiddlers Green At Edenton	5911 Genesis Lane	X-unshaded	N	Other	short_1	combo-hi	6	none
Nursing and Care Facility	Garden House At Edenton	5849 Genesis Lane	X-unshaded	N	Other	short_1	combo-hi	6	none
Nursing and Care Facility	Orchard Terrace At Edenton	5905 Edenton Court	X-unshaded	N	Other	short_1	combo-hi	6	none
Nursing and Care Facility	Sunset Ridge Assisted Living, Inc.	7021 Rock Creek Drive	X-unshaded	N	Interface	none	combo-hi	6	none
Nursing and Care Facility	Vindobona Nursing And Rehabilitation Center		X-unshaded	N	Intermix	none	combo-hi	6	none
Post Office	Braddock Heights Post Office	4707 Schley Avenue, Braddock Heights, MD 21714	X-unshaded	N	Interface	none	combo-hi	6	none
Post Office	Middletown Post Office	7227 Hollow Road, Middletown, MD 21769	X-unshaded	N	Interface	none	combo-hi	6	none
Post Office	Adamstown Post Office	5537 Mountville Road, Adamstown, MD 21710	X-unshaded	N	Other	short_1	low	6	none
Post Office	Buckeystown Post Office	4001 Buckeystown Pike, Buckeystown, MD 21717	X-unshaded	N	Other	none	low	6	none
Post Office	Sabillasville Post Office	17235 Sabillasville Road, Sabillasville, MD 21719	X-unshaded	N	Interface	short_3	combo-hi	6	none
Post Office	Monrovia Post Office	4411 Green Valley Road, Monrovia, MD 21770	X-unshaded	N	Other	none	low	6	none
Post Office	Jefferson Post Office	3702 Jefferson Pike, Jefferson, MD 21755	X-unshaded	N	Interface	none	combo-hi	6	none
Post Office	Ladiesburg Post Office	12509 Woodsboro Pike, Ladiesburg, MD 21759	X-unshaded	N	Other	none	low	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Post Office	New Midway Post Office	12048a Woodsboro Pike, New Midway, MD 21775	X-unshaded	N	Other	none	combo-hi	6	none
Post Office	Rocky Ridge Post Office	13516 Motters Station Road, Rocky Ridge, MD 21778	X-unshaded	N	Other	none	combo-hi	6	none
Post Office	Libertytown Post Office	11941 Main Street, Libertytown, MD 21762	X-unshaded	N	Other	none	low	6	none
Post Office	Point of Rocks Post Office	1597 Bowis Drive, Point Of Rocks, MD 21777	X-unshaded	N	Other	short_1	combo-hi	6	none
Post Office	Tuscarora Post Office	5709a Tuscarora Road, Tuscarora, MD 21790	X-unshaded	N	Other	none	low	6	none
Public Facility	Business And Employment Center	5340a Spectrum Drive, Frederick MD 21703	X-unshaded	N	Other	short_1	low	6	none
Public Facility	Landfill	9031 Reich's Ford Road, Frederick MD 21701	X-unshaded	N	Intermix	none	low	6	none
Public Facility	Public Safety Training Facility 27	5370 Public Safety Place, Frederick, MD 21704-6677	X-unshaded	N	Other	short_1	low	6	none
Public Facility - Govt Admin	Duswm Metropolitan Court	4520 Metropolitan Court, Frederick MD 21704	X-unshaded	N	Other	short_1	low	6	none
Public Facility - Maintenance	Urbana Highway Fleet Maintenance	3471-A Campus Drive, Ijamsville, MD	X-unshaded	N	Other	none	low	6	none
Public Facility - Maintenance	Jefferson Highway Fleet Mainteance	3401 Burgee Drive, Jefferson, MD	X-unshaded	N	Interface	none	combo-hi	6	none
Public Facility - Maintenance	Myersville Highway Fleet Maintenance	10917 Pleasant Walk Road, Myersville, MD	X-unshaded	N	Interface	short_3	sus_mod	6	none
Public Facility - Maintenance	Thurmont Highway Fleet Maintenance	7407 Blue Mountain Road Thurmont, MD	X-unshaded	N	Intermix	none	combo-hi	6	none
Public Facility - Maintenance	Johnsville Highway Maintenance yard	13216 Coppermine Road, Union Bridge	X-unshaded	N	Other	none	low	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Public School	Liberty Elementary	11820 Liberty Road	X-unshaded	N	Intermix	none	low	6	none
Public School	Sabillasville Elementary	16210-B Sabillasville Road	X-unshaded	N	Interface	short_3	combo-hi	6	none
Public School	Catoctin High	14745 Sabillasville Road	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Wolfsville Elementary	12520 Wolfsville Road	X-unshaded	N	Interface	short_3	sus_mod	6	none
Public School	New Midway Elementary	12226 Woodsboro Pike	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Lewistown Elementary	11119 Hessong Bridge Road	X-unshaded	N	Interface	none	combo-hi	6	none
Public School	Yellow Springs Elementary	8717 Yellow Springs Road	X-unshaded	N	Interface	none	combo-hi	6	none
Public School	Orchard Grove Elementary	5898 Hannover Drive	X-unshaded	N	Other	short_1	combo-hi	6	none
Public School	Spring Ridge Elementary	9051 Ridgefield Drive	X-unshaded	N	Other	short_1	low	6	none
Public School	Deer Crossing Elementary	10601 Finn Drive	X-unshaded	N	Other	none	low	6	none
Public School	New Market Middle	125 West Main Street	X-unshaded	N	Other	none	low	6	none
Public School	Kemptown Elementary	3456 Kemptown Church Road	X-unshaded	N	Other	none	low	6	none
Public School	Green Valley Elementary	11501 Fingerboard Road	X-unshaded	N	Other	none	low	6	none
Public School	Urbana Elementary	3554 Urbana Pike	X-unshaded	N	Other	none	low	6	none
Public School	Ballenger Creek Elementary	5250 Kingsbrook Drive	X-unshaded	N	Other	short_1	low	6	none
Public School	Carroll Manor Elementary	5624 Adamstown Road	X-unshaded	N	Other	short_1	low	6	none
Public School	Valley Elementary	3519 Jefferson Pike	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Oakdale Elementary	9850 Old National Pike	X-unshaded	N	Other	none	low	6	none
Public School	Oakdale Middle	9840 Old National Pike	X-unshaded	N	Other	none	low	6	none
Public School	Urbana High	3471 Campus Drive	X-unshaded	N	Other	none	low	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Public School	Windsor Knolls Middle	1150 Windsor Road	X-unshaded	N	Other	none	low	6	none
Public School	Linganore High	12013 Old Annapolis Road	X-unshaded	N	Other	none	low	6	none
Public School	Ballenger Creek Middle	5525 Ballenger Creek Pike	X-unshaded	N	Other	short_1	combo-hi	6	none
Public School	Tuscarora High	5312 Ballenger Creek Pike	X-unshaded	N	Other	short_1	combo-hi	6	none
Public School	Tuscarora Elementary	6321 Lambert Drive	X-unshaded	N	Other	short_1	low	6	none
Public School	Crestwood Middle	7100 Foxcroft Drive	X-unshaded	N	Other	short_1	low	6	none
Public School	Urbana Middle	3511 Pontius Court	X-unshaded	N	Other	none	low	6	none
Public School	Centerville Elementary	3601 Carriage Hill Drive	X-unshaded	N	Other	none	low	6	none
Public School	Oakdale High	5850 Eaglehead Drive	X-unshaded	N	Intermix	none	low	6	none
Radio Tower	Mar Lu Ridge Radio Tower		X-unshaded	N	Intermix	none	combo-hi	6	none
Radio Tower	New Market Radio Tower		X-unshaded	N	Other	none	low	6	none
Radio Tower	Gambrill Radio Tower		X-unshaded	N	Other	none	combo-hi	6	none
Radio Tower	Tower Road Radio Tower		X-unshaded	N	Intermix	short_3	combo-hi	6	none
Radio Tower	Bridgeport Radio Tower	Bridgeport Road	A	N	Other	none	low	6	none
Transportation	Monocacy MARC Station	7800 Genstar	X-unshaded	N	Other	short_1	low	6	none
Transportation	Point of Rocks MARC Station	4000 Clay Street	A	N	Other	none	combo-hi	6	none
Transportation	Union Bridge Highway Fleet Maintenance	13216 Coppermine Road, Union Bridge, MD	X-unshaded	N	Other	none	low	6	none
WTP	Key Water Treatment Plant	7413 Shockley Drive	X-unshaded	N	Other	short_1	low	6	none
WTP/WWTP	Sewer	Bentzel Road	X-unshaded	N	Interface	short_3	combo-hi	6	none
WTP/WWTP	Sewer	College Lane	X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Sewer		X-unshaded	N	Other	short_3	combo-hi	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
WTP/WWTP	Sewer		X-unshaded	N	Interface	none	combo-hi	6	none
WTP/WWTP	Sewer	Moser Road	A	N	Interface	none	combo-hi	6	Hunting Creek Dam Inundation Area
WTP/WWTP	Sewer		X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Sewer	Interstate 70	X-unshaded	N	Intermix	short_3	sus_mod	6	none
WTP/WWTP	Sewer	Hessong Bridge Road	X-unshaded	N	Interface	none	combo-hi	6	none
WTP/WWTP	Sewer	Bethel Road	X-unshaded	N	Interface	none	combo-hi	6	none
WTP/WWTP	Sewer	Quail Knob Lane	A	N	Interface	none	combo-hi	6	none
WTP/WWTP	Sewer	Westport Drive	X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Sewer	Creamery Court	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Sewer		X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Sewer	Beech Tree Lane	AE	N	Other	none	combo-hi	6	none
WTP/WWTP	Sewer	Holter Road	X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Sewer	Greenfield Dirve	AE	N	Other	short_1	combo-hi	6	none
WTP/WWTP	Sewer		X-unshaded	N	Other	short_1	combo-hi	6	none
WTP/WWTP	Sewer	Bye Alley	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Sewer	Baldwin Road	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Sewer	Marcies Choice Lane	X-unshaded	N	Other	short_1	low	6	none
WTP/WWTP	Sewer		X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Sewer	Kemptown Church Road	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Sewer	Manor Woods Road	X-unshaded	N	Other	short_1	low	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
WTP/WWTP	Sewer	Graymarsh Court	X-unshaded	N	Intermix	none	low	6	none
WTP/WWTP	Sewer	Rock Hall Road	A	N	Other	short_1	combo-hi	6	none
WTP/WWTP	Sewer	Bill Moxley Road	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Sewer		X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Sewer		X-unshaded	N	Intermix	none	combo-hi	6	none
WTP/WWTP	Sewer		X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Sewer		X-unshaded	N	Other	short_1	low	6	none
WTP/WWTP	Water Facility		X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Water Facility		X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Water Facility		X-unshaded	N	Intermix	short_3	sus_mod	6	none
WTP/WWTP	Water Facility		X-unshaded	N	Intermix	none	combo-hi	6	Fish Creek Dam inundation area
WTP/WWTP	Water Facility	Christophers Crossing	X-unshaded	N	Interface	none	combo-hi	6	none
WTP/WWTP	Water Facility	Main Street	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Water Facility	Riverside Place	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Water Facility	Shockley Drive	X-unshaded	N	Other	short_1	low	6	none
WTP/WWTP	Water Facility	Plant Road	X-unshaded	N	Other	short_1	low	6	Lake Linganore inundation area
WTP/WWTP	Water Facility	Eaglehead Drive	X-unshaded	N	Other	none	low	6	Lake Linganore inundation area
WTP/WWTP	Water Facility	Moss Rock Way	X-unshaded	N	Other	none	low	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
WTP/WWTP	Water Facility	S Reyburn Court	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Water Facility	Westport Drive	X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Water Facility	Stockton Place	X-unshaded	N	Interface	none	combo-hi	6	none
WTP/WWTP	Water Facility	Windsor Road	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Water Facility	Cracked Bell Court	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Water Facility	Stone Ridge Drive	X-unshaded	N	Interface	none	combo-hi	6	none
WTP/WWTP	Water Facility	Samhill Drive	X-unshaded	N	Interface	none	low	6	none
WTP/WWTP	Water Facility	Beechtree Drive	X-unshaded	N	Interface	none	combo-hi	6	none
WTP/WWTP	Water Facility	Wicomico Drive	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Water Facility	Misty Hollow Road	X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Water Facility	Thomas Drive	X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Water Facility	Ballenger Creek Pike	X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Water Facility		X-unshaded	N	Other	short_1	combo-hi	6	none
WTP/WWTP	Water Facility		X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Water Facility		X-unshaded	N	Other	none	low	6	none
WWTP	Ballenger Creek WWTP	7303 Marcie's Choice Lane	AE	N	Other	short_1	low	6	none
WWTP	New Design WWTP	850 New Design Road, Tuscarora	X-unshaded	N	Other	short_1	low	6	none
Walkersville									
Fire/EMS	Walkersville Volunteer Rescue Company	73 W Frederick Street	X-unshaded	N	Other	none	low	6	none
Fire/EMS	Walkersville Volunteer Fire Company	73 W Frederick Street, P.O. Box 425, Walkersville, MD 21793	X-unshaded	N	Other	none	low	6	none

Facility Type	Critical Facility Name	Site Address	Flood Zone	Floodway	Wildfire/Wildland Urban Interface	Karst	Landslide	Earthquake	Dam/Levee Failure
Library	Walkersville Library	57 W Frederick Street	X-unshaded	N	Other	none	low	6	none
Nursing and Care Facility	Glade Valley Center	56 West Frederick Street, Walkersville, 21793	X-unshaded	N	Other	none	low	6	none
Nursing and Care Facility	Devotion Assisted Living LLC		X-unshaded	N	Other	none	low	6	none
Post Office	Walkersville Post Office	7 E Frederick Street, Walkersville, MD 21793	X-unshaded	N	Other	none	low	6	none
Public Facility	Walkersville Town Hall	21 W Frederick Street	X-unshaded	N	Other	none	low	6	none
Public School	Glade Elementary	9525 Glade Road	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Walkersville Elementary	93 Frederick Street	X-unshaded	N	Other	none	low	6	none
Public School	Walkersville Middle	55 Frederick Street	X-unshaded	N	Other	none	low	6	none
Public School	Walkersville High	81 Frederick Street	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Water Facility		X-unshaded	N	Other	none	combo-hi	6	none
Woodsboro									
Fire/EMS	Woodsboro Volunteer Fire Company	2 S Third Street	X-unshaded	N	Other	none	combo-hi	6	none
Post Office	Woodsboro Post Office	602 S Main Street, Woodsboro, MD 21798	X-unshaded	N	Other	none	combo-hi	6	none
Public Facility	Woodsboro Town Office	2 S Third Street	X-unshaded	N	Other	none	combo-hi	6	none
Public School	Woodsboro Elementary	101 Liberty Road	X-unshaded	N	Other	none	combo-hi	6	none
WTP/WWTP	Sewer	Council Drive	X-unshaded	N	Other	none	low	6	none
WTP/WWTP	Water Facility		X-unshaded	N	Other	none	combo-hi	6	none

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Appendix B: 2009 Mitigation Projects Update

This Appendix contains an update on the status of projects from the 2009 Hazard Mitigation Plan. The list below contains only those projects Planning Committee members decided not to carry over into the 2015 plan. 2009 projects that were carried over as 2015 actions are found in Chapter 5 of this Plan.

Project 3
Description of Project: Develop and broadcast public service announcements (PSAs) on the immediate steps to be taken after a storm, to be disseminated immediately after the hazard occurs on Cable Channel 99 and WFMD, WFRE, and KEY 103.1 radio stations.
Applicable Goal: Goal 1: Promote public understanding, support, and involvement in hazard mitigation activities.
Objective: Develop a countywide public information and education program to advise citizens on how to protect themselves and their property from natural hazard events.
Responsible Organizations: Department of Emergency Preparedness, local TV station, radio stations.
Estimated Costs: Cost of information placement may vary by station.
Possible Funding Sources: General fund; pro-bono donation by broadcasters.
Timeline for Implementation: Ongoing.
Status Since 2009: Completed. *Comments:* Ran information on what to do before and after the storm on channel 99 as well as did interviews with local radio stations. We also worked with the Citizen Corps Council to develop and information campaign using social media.
Priority: High.

Project 4
Description of Project: Outreach projects are the first step in informing property owners about property protection measures and in encouraging and assisting them in designing and implementing a project. The Department of Emergency Preparedness will develop and run a public information campaign with displays, lectures, and other projects. Local libraries will be used as venues for these events. As such, public outreach projects will include information on property protection measures. Research has shown that targeted local information programs are more effective than national advertising or publicity campaigns. Therefore, outreach projects will be locally designed and tailored to meet local conditions. Because the west side of the City of Frederick contains an apartment complex that is predominantly Hispanic and other parts of the city also have pockets of Hispanic populations, informational materials will be prepared in English and Spanish. Educate citizens by teaching disaster preparedness at various locations throughout the county. Conduct road shows in schools and other various organizations and identify schools, fire halls, churches, and other non-profit organizations such as the Rotary Club, Kiwanis Club, etc., throughout the County that could be used as meeting areas and where presentations on awareness, prevention, preparedness, response, and recovery could be conducted. A PowerPoint presentation will be prepared that will be made available to these organizations on a regular basis. Booklets such as Are You Ready by FEMA will also be distributed at these presentations with the ultimate objective of providing information to children who will take it to

their families. The Department of Emergency Preparedness will conduct a road show in the local schools and use the prepared presentation to educate students.
Applicable Goal: Goal 1: Promote public understanding, support, and involvement in hazard mitigation activities.
Objective: Develop a countywide public information and education program to advise citizens on how to protect themselves and their property from natural hazard events.
Responsible Organizations: Department of Emergency Preparedness, Frederick County Schools, service clubs, volunteer fire departments – municipalities.
Estimated Costs: Regular employee pay.
Possible Funding Sources: No funding required.
Timeline for Implementation: Yearly.
Status Since 2009: Ongoing. *Comments:* DEM target Public awareness/outreach events in local communities and with area organizations to help improve education. This type of education will never be completed; it is part of what DEM does on a daily basis. This type of aggressive outreach is no longer sustainable because of a reduction in Department of Emergency Management staffing.
Priority: High.

Project 6
Description of Project: The Frederick County Emergency Operations Plan is currently under revision. Ensure integration of the Hazard Mitigation Plan with the Emergency Plan.
Applicable Goal: Goal 2: Reduce exposure to natural hazards through local planning and ordinances.
Objective: Review and recommend changes to the county comprehensive plan, sub-area plans, municipal plans, and existing ordinances (zoning, subdivision, and floodplain) as appropriate.
Responsible Organizations: Department of Emergency Preparedness, Fire Department, county Sheriff's Office.
Estimated Costs: Staff salaries.
Possible Funding Sources: No funding required.
Timeline for Implementation: 2 to 5 years.
Status Since 2009: Completed. *Comments:* Completed - Our Base EOP and annexes all have a section dedicated to mitigation actions.
Priority: High.

Project 9
Description of Project: Develop and distribute public outreach materials addressing building to safe standards.
Applicable Goal: Goal 3: Reduce exposure of structures, infrastructure, and contents to hazards.
Objective: Create an awareness of building to safe standards.
Responsible Organizations: Department of Emergency Preparedness, Permitting, and Development Review.
Estimated Costs: $2,000 per year.
Possible Funding Sources: HMGP.
Timeline for Implementation: 6 months from secured funding.
Status Since 2009: Not started.

Comments: We decided not to develop our own materials because so much information has already been developed. We include this type of information as part of our public awareness and outreach.
Priority: Low.

Project 12
Description of Project: Conduct inspections of critical facilities to assess each facility's ability to sustain severe weather incidents and determine potential structural damages. Determine retrofitting or structural enhancements/replacements that may be needed as a result of the assessment.
Applicable Goal: Goal 3: Reduce exposure of structures, infrastructure, and contents to hazards.
Objective: Create an awareness of building to safe standards.
Responsible Organizations: Department of Emergency Preparedness.
Estimated Costs: Engineering consulting fees.
Possible Funding Sources: To be determined.
Timeline for Implementation: 6 to 10 years.
Status since 2009: Completed. *Comments:* We reviewed each County site and identified probable types of damage based on different hazards. This information is used to help identify which structures should be evaluated first after an event.
Priority: Medium.

Project 13
Description of Project: Encourage safety in temporary classrooms in schools. Many portable classrooms have been built with an aluminum roof, thin trailer aluminum exterior, small windows, a residential grade door, doorframe, and lockset, wood underlayment, studs and walls, and minimum lighting and ventilation. Non-combustible classrooms should be considered in Frederick County Public Schools. These consist of doublewide classrooms built on a rigid steel frame, with lightweight concrete floors and fiberglass reinforcement offering the feel of site-built construction. The new non-combustible structure sits on the ground and eliminates the need for the costly steps, decks, and ramps. This not only minimizes installation costs, but also eliminates a potential mold problem. Refer to http://www.mbinet.org/web/magazine/studyin5_01.html for additional details on non-combustible classrooms.
Applicable Goal: Goal B: Reduce exposure of structures, infrastructure, and contents to hazards.
Objective: Create an awareness of building to safe standards.
Responsible Organizations: Department of Emergency Preparedness, Frederick County Public Schools (FCPS).
Estimated Costs: To be determined.
Possible Funding Sources: HMGP.
Timeline for Implementation: 6 to 10 Years.
Status Since 2004: Not started. *Comments:* Frederick County public schools moves their existing temporary classrooms to different sites based on need. New classrooms purchased meet current standards. To improve the safety of students and staff using temporary classrooms, FCPS partnered with Emergency Management to purchase Alertus warning beacons. These beacons were installed in the main office of every public school and automatically sound for Tornado Warnings and Severe Thunderstorm Warnings.

Priority: Low.

Project 15
Description of Project: Make available the karst topography brochure for sinkholes titled "A Users Guide to Karst and Sinkholes in Western Maryland" that has been developed by the Western Maryland Resource Conservation and Development Council.
Applicable Goal: Goal 4*:* Reduce Frederick County's vulnerability to sinkholes.
Objective: Continue to educate Frederick County residents on karsts.
Responsible Organizations: Department of Emergency Preparedness.
Estimated Costs: Regular employee pay for content and layout preparation, approximately $2 each for printing a tri-fold brochure.
Possible Funding Sources: No funding required.
Timeline for Implementation: 1 year.
Status Since 2009: Completed. *Comments:* The brochure was downloaded via the Conservation and Development Council website and is used as a resource to educate the public. Because the report was published in 2004, the information is dated so we do not distribute the brochure but use the relevant information.
Priority: High.

Project 19
Description of Project: Consider the benefits of enrolling Frederick County in the CRS. The NFIP CRS program was established to encourage communities to do more than the minimum when it comes to administering their individual floodplain management programs. All activities that the county undertakes that they wish to be considered above the minimum are documented and submitted for verification. Points are awarded for the various activities. For each set of 500 points earned, flood insurance premiums are lowered by 5 percent inside the SFHA (for homes outside of the SFHA, discounts vary based on CRS ratings). Once the CRS application is completed, it should be reviewed by the Insurance Services Organization (the contractor that administers the CRS program for FEMA) for accuracy and completeness.
Applicable Goal: Goal 6: Develop measures to protect all buildings (commercial, residential, and industrial) that are in the floodplain.
Objective: Continue to ensure that the current building codes, floodplain ordinances, and/or standards are kept current, follow FEMA guidelines, and are properly enforced.
Responsible Organizations: Department of Emergency Preparedness, Division of Planning.
Estimated Costs: Regular employee pay.
Possible Funding Sources: No funding required.
Timeline for Implementation: 6 to 10 years.
Status Since 2009: Not started. *Comments:* Division of Emergency Management performed an analysis based on the CRS requirements and it was determined that the County would not pursue entering the CRS program.
Priority: High.

Project 23
Description of Project: Flooding in low-lying areas such as Maryland Route 550 at Israel Creek and Maryland Route 355 at Bennett's Creek are major areas of concern. These low-lying areas experience shallow flooding that typically occurs following snowmelt or high-volume

rainfalls that often cause a significant amount of damage. Assess these areas to determine the best mitigation solution, such as improving the storm drain system, elevating the roadway, etc.
Applicable Goal: Goal 5*:* Investigate structural solutions to flooding problems.
Objective: Investigate the feasibility of enhancing and/or improving drainage of flood-prone lands.
Responsible Organizations: Department of Emergency Preparedness, Division of Public Works, Maryland State Highway Administration.
Estimated Costs: To be determined.
Possible Funding Sources: Flood Mitigation Assistance, HMGP.
Timeline for Implementation: 6 to 10 years.
Status Since 2009: Not started. *Comments:* The county has discussed these sites with State Highway Administration.
Priority: High.

Project 25
Description of Project: Ensure that high-risk, pre-FIRM residential structures do not experience repeat flooding by using retrofitting techniques to reduce the flood risk to the properties by developing a "flood inventory" of all repetitive loss structures. The Maryland Department of the Environment will provide the names and addresses of repetitively flooded properties (those having two or more claims of $1,000 or more within any 10-year period of time); however, FEMA has records only of those properties with flood insurance. The County will therefore need to rely on their own records to determine repetitively flooded properties that do not carry flood insurance. Consider procuring the services of a consulting engineer/surveyor to determine and inventory the following on repetitive loss structures: first floor elevation, basement elevation, lowest opening, lowest adjacent ground grade, type of construction, use, and condition. Continue to maintain acquisition plans or mitigation strategies for repetitively flooded properties. In residences that lose their basements due to elevating the home above the floodplain, include the construction of a "safe room" in the retrofitted structure on the first floor.
Applicable Goal: Goal 6: Develop measures to protect all buildings (commercial, residential, and industrial) that are in the floodplain.
Objective: Develop flood mitigation strategies for flood-prone properties.
Responsible Organizations: Division of Planning, Department of Emergency Preparedness.
Estimated Costs: Regular employee pay.
Possible Funding Sources: No funding required.
Timeline for Implementation: 1 year.
Status Since 2009: Not started. *Comments:* No funding.
Priority: Low.

Project 26
Description of Project: Fund the purchase and delivery of public outreach materials, e.g., website, brochures, advertisements, public service announcements, etc., that educate citizens on the concept of defensible spaces.
Applicable Goal: Goal 7: Reduce the risk to wildland and urban interface wildfires in the county.
Objective: Continue to promote the concept of defensible spaces to county residents.

Responsible Organizations: Department of Emergency Preparedness, Division of Permitting and Development Review, and Division of Fire and Rescue.
*Estimated Costs: $*2,000 to $3,000 per year.
Possible Funding Sources: HMGP.
Timeline for Implementation: 2 years after funding secured.
Status since 2009: Completed. *Comments:* Provided information related to Forest fires as part of our public awareness and outreach.
Priority: Low.

Project 28
Description of Project: Recommendations from all countywide or regional evacuation plans that have been developed for adjacent areas should be integrated into Frederick County's Evacuation Plan to ascertain smooth transition, traffic flow, etc. A number of studies have been conducted with respect to evacuation. The following studies should be taken into account while developing these evacuation routes: the Baltimore Council of Governments and the Washington, DC, Council of Governments have completed evacuation and sheltering plans for the region; the Maryland State Highway Administration has a plan on roads in and around Frederick County that may get blocked during an emergency. All major highways such as Maryland Route15, Interstate 70, Interstate 270, and Maryland Route 340 and the Frederick County Fairgrounds are areas that would require particular attention.
Applicable Goal: Goal 8: Ensure safe and efficient evacuation routes to and from Frederick County.
Objective: Coordinate with Local, State and regional partners to provide safe and efficient evacuation routes.
Responsible Organizations: Department of Emergency Preparedness, Department of Highways and Transportation, Sheriff's Office.
Estimated Costs: $ 50,000.
Possible Funding Sources: DHS.
Timeline for Implementation: 2 to 5 years.
Status Since 2009: Ongoing. *Comments:* SHA has developed traffic plans that are implemented to route traffic around closures on major state roads. Frederick County participates with the National Capital Region on evacuation planning initiatives.
Priority: Medium.

Project 41 - Brunswick
Description of Project: Provide generators at the Fire Department Building.
Applicable Goal: Goal 11: Identify community-specific needs to reduce risks to various hazards.
Objective: The Department of Emergency Preparedness will continue to work with all the municipalities in the County to identify needs, abilities, and resources to implement appropriate mitigation efforts.
Responsible Organizations: City of Brunswick, Department of Emergency Preparedness.
Estimated Costs: Varies based on size, horse power, etc.
Possible Funding Sources: DHS EMPG.
Timeline for Implementation: 2 to 5 years.
Status Since 2009: Completed.

Comments: The Brunswick Volunteer Fire company built a new fire station with a generator in 2012.
Priority: High.

Project 42 - Middletown
Description of Project: To construct an Emergency Alert System Tower in the Town of Middletown.
Applicable Goal: Goal 10: Improve severe weather notification in the community.
Objective: Improve access in the County to severe weather and emergency notifications.
Responsible Organizations: Town of Middletown, Frederick County.
Estimated Costs: TBD.
Possible Funding Sources: HMGP, PDM.
Timeline for Implementation: 2 years.
Status since 2009: Completed. *Comments:* None.
Priority: Medium.

Project 46 - Walkersville
Description of Project: To construct an emergency water line from the County in case the town water supply becomes polluted from runoff, flooding, etc.
Applicable Goal: Goal 11: Identify community-specific needs to reduce risks to various hazards.
Objective: The Department of Emergency Preparedness will continue to work with all the municipalities in the County to identify needs, abilities, and resources to implement appropriate mitigation efforts.
Responsible Organizations: Department of Public Works.
Estimated Costs: TBD.
Possible Funding Sources: HMGP, PDM.
Timeline for Implementation: 2 years.
Status since 2009: Not started. *Comments:* Not completed due to lack of funding and engineering challenges. Town plans to construct new water plant that can treat potential pollutants in water supply.
Priority: Medium.

Appendix C: Maps

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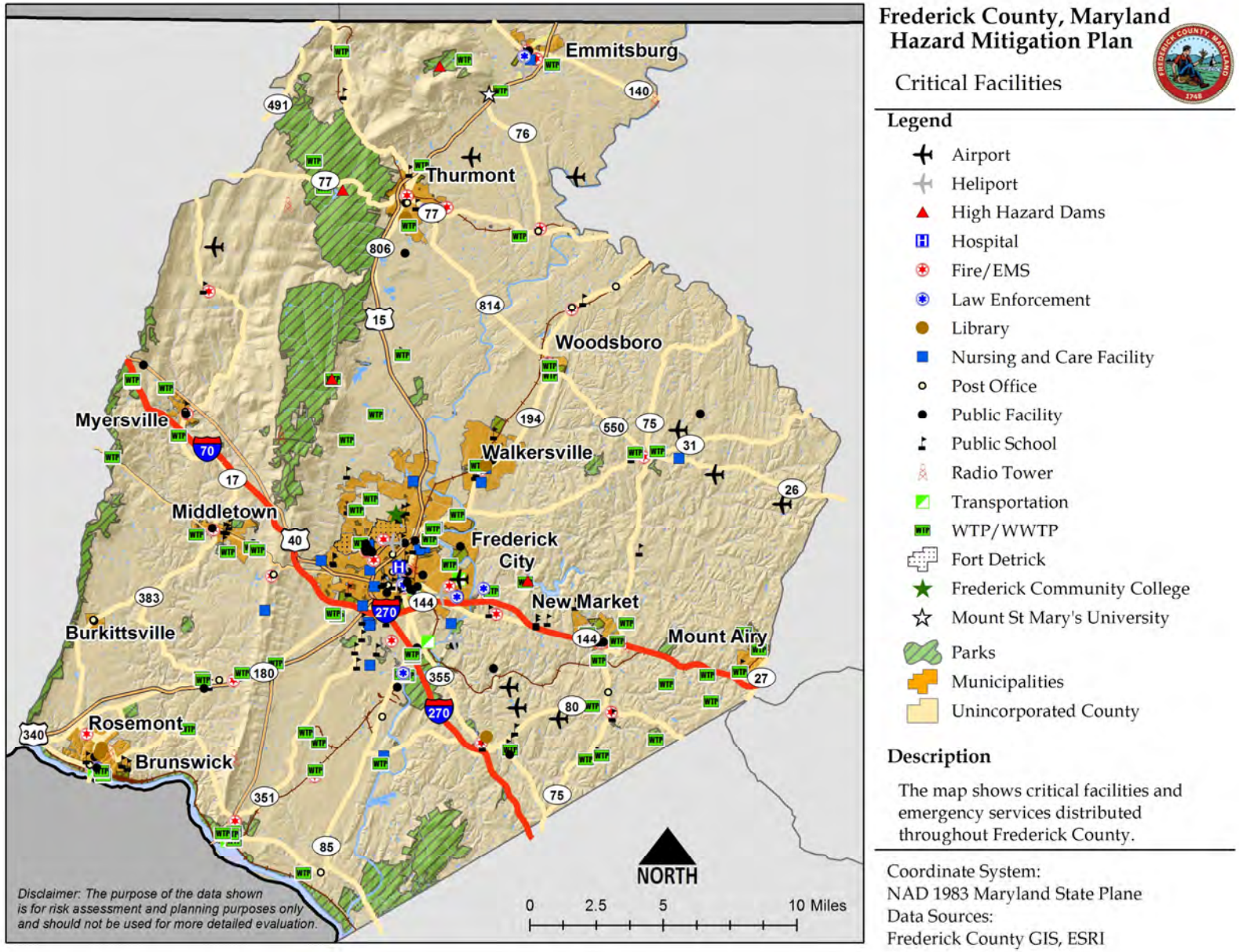


Figure C.1 Frederick County Critical Facilities

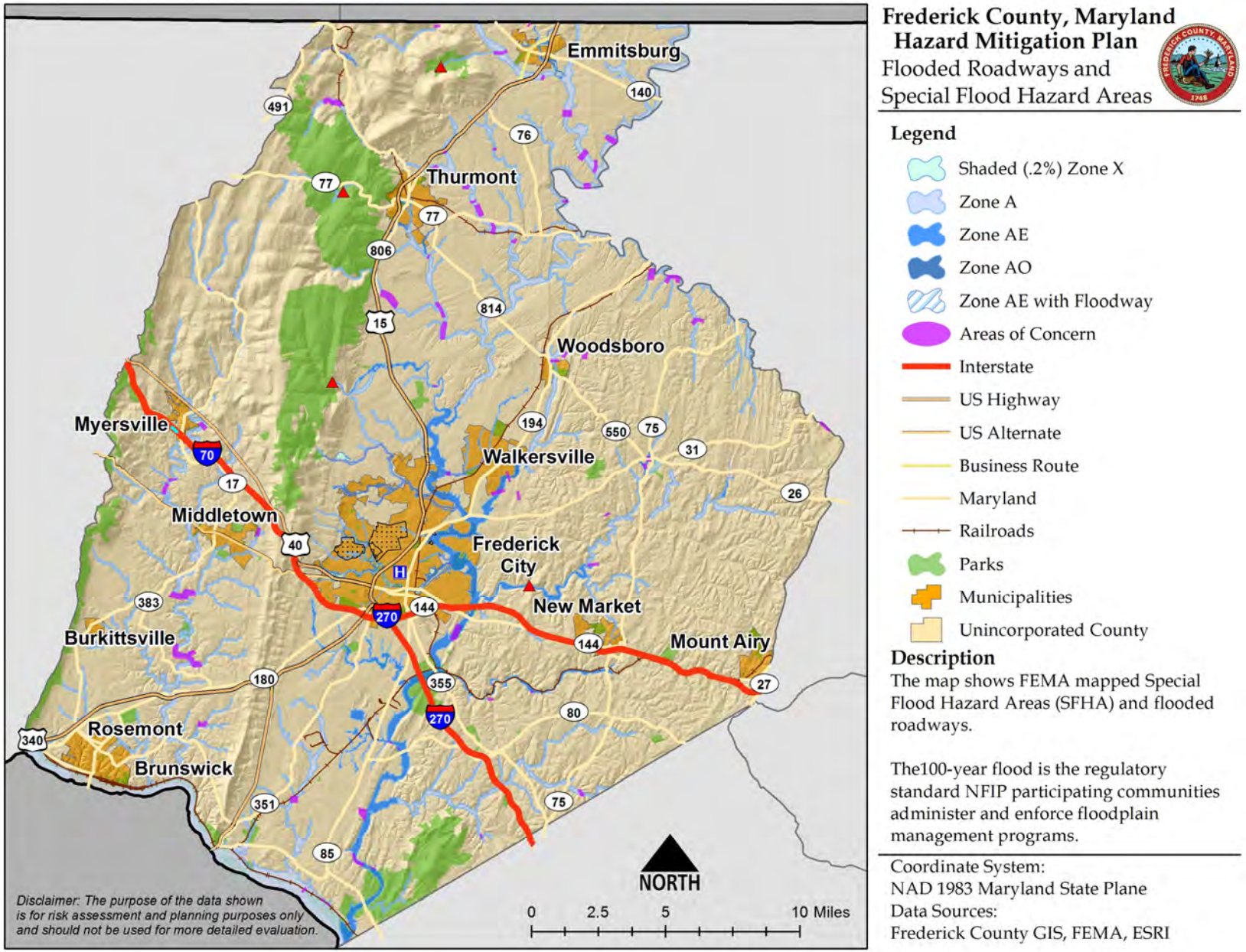


Figure C.2 Frederick County Special Flood Hazard Area (SFHA)

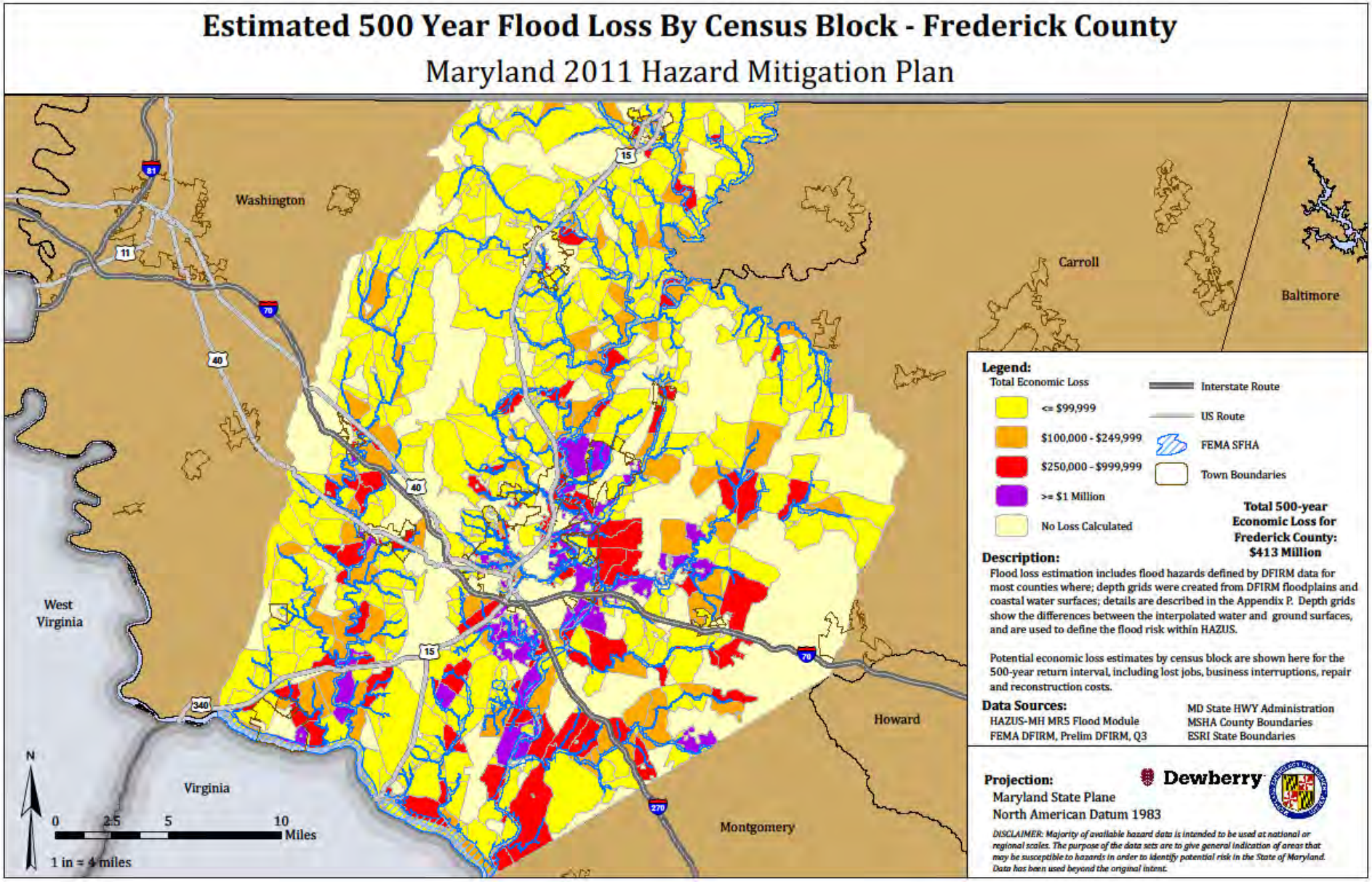
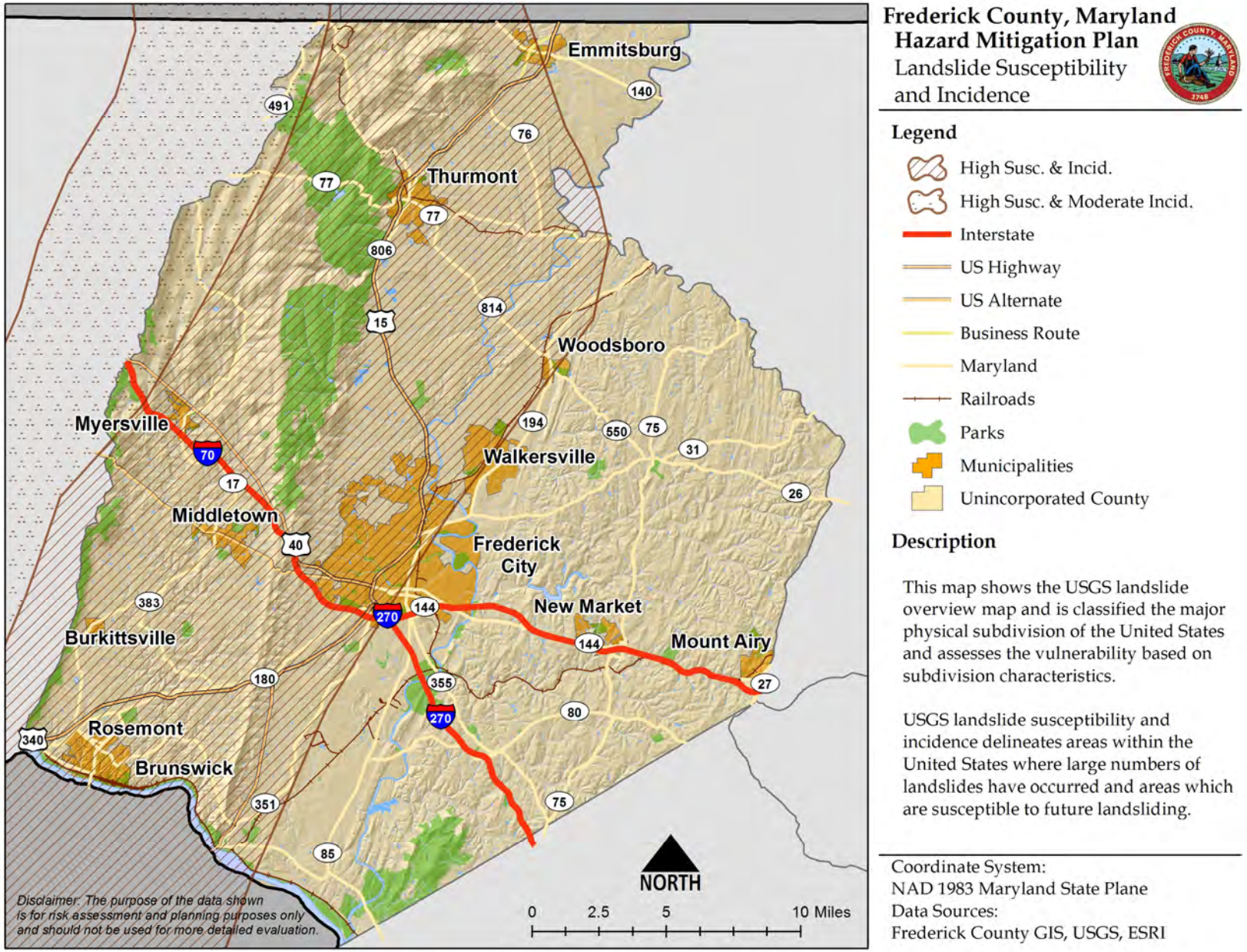


Figure C.3 500 Year Flood Loss by Census Block



Frederick County, Maryland
Hazard Mitigation Plan
Landslide Susceptibility and Incidence

Legend

- High Susc. & Incid.
- High Susc. & Moderate Incid.
- Interstate
- US Highway
- US Alternate
- Business Route
- Maryland
- Railroads
- Parks
- Municipalities
- Unincorporated County

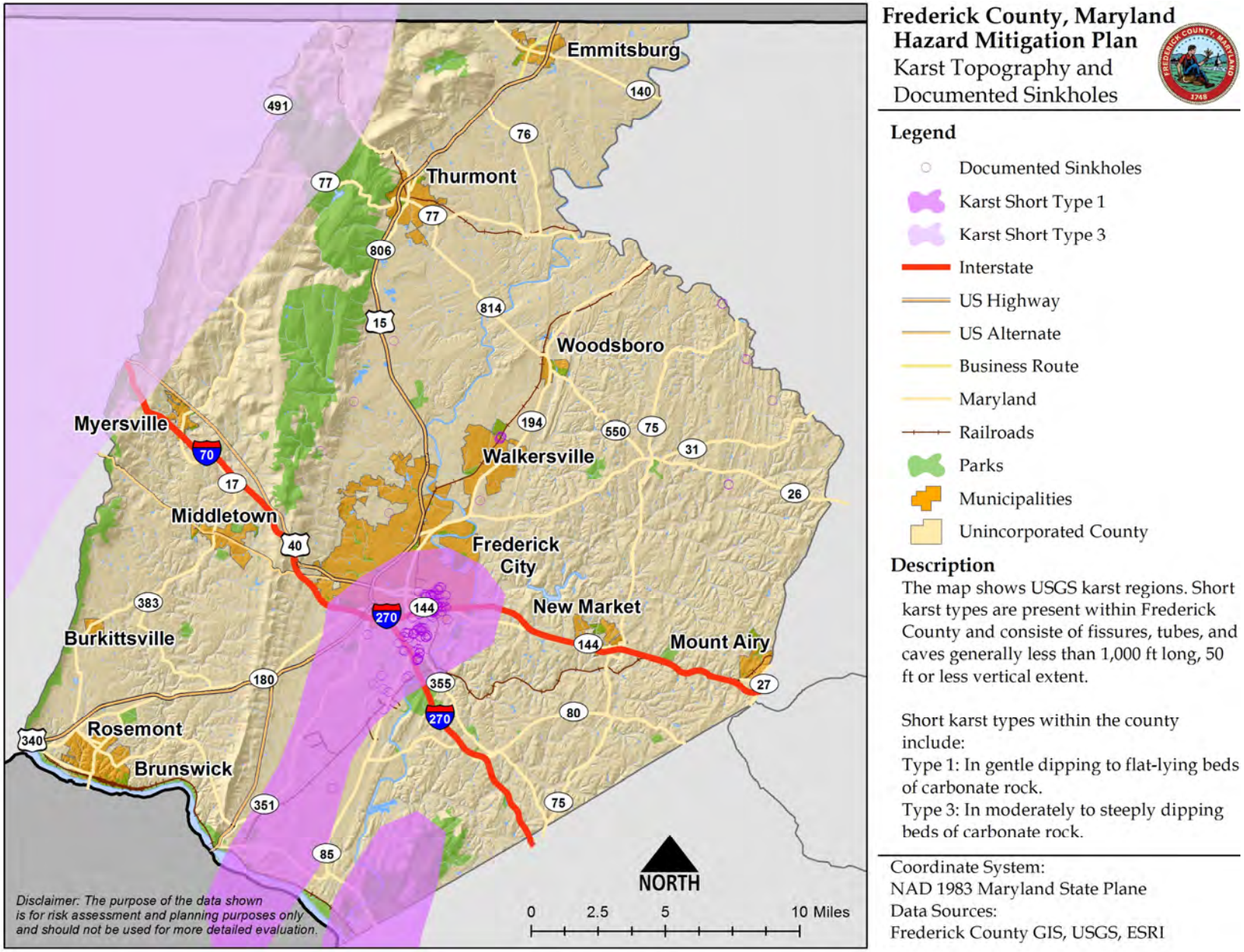
Description

This map shows the USGS landslide overview map and is classified the major physical subdivision of the United States and assesses the vulnerability based on subdivision characteristics.

USGS landslide susceptibility and incidence delineates areas within the United States where large numbers of landslides have occurred and areas which are susceptible to future landsliding.

Coordinate System:
NAD 1983 Maryland State Plane
Data Sources:
Frederick County GIS, USGS, ESRI

Figure C.4 Frederick County USGS Landslide Susceptibility



Frederick County, Maryland
Hazard Mitigation Plan
Karst Topography and Documented Sinkholes

Legend

- Documented Sinkholes
- Karst Short Type 1
- Karst Short Type 3
- Interstate
- US Highway
- US Alternate
- Business Route
- Maryland
- Railroads
- Parks
- Municipalities
- Unincorporated County

Description

The map shows USGS karst regions. Short karst types are present within Frederick County and consiste of fissures, tubes, and caves generally less than 1,000 ft long, 50 ft or less vertical extent.

Short karst types within the county include:
Type 1: In gentle dipping to flat-lying beds of carbonate rock.
Type 3: In moderately to steeply dipping beds of carbonate rock.

Coordinate System:
NAD 1983 Maryland State Plane
Data Sources:
Frederick County GIS, USGS, ESRI

Figure C.5 Karst Topography and Documented Sinkholes

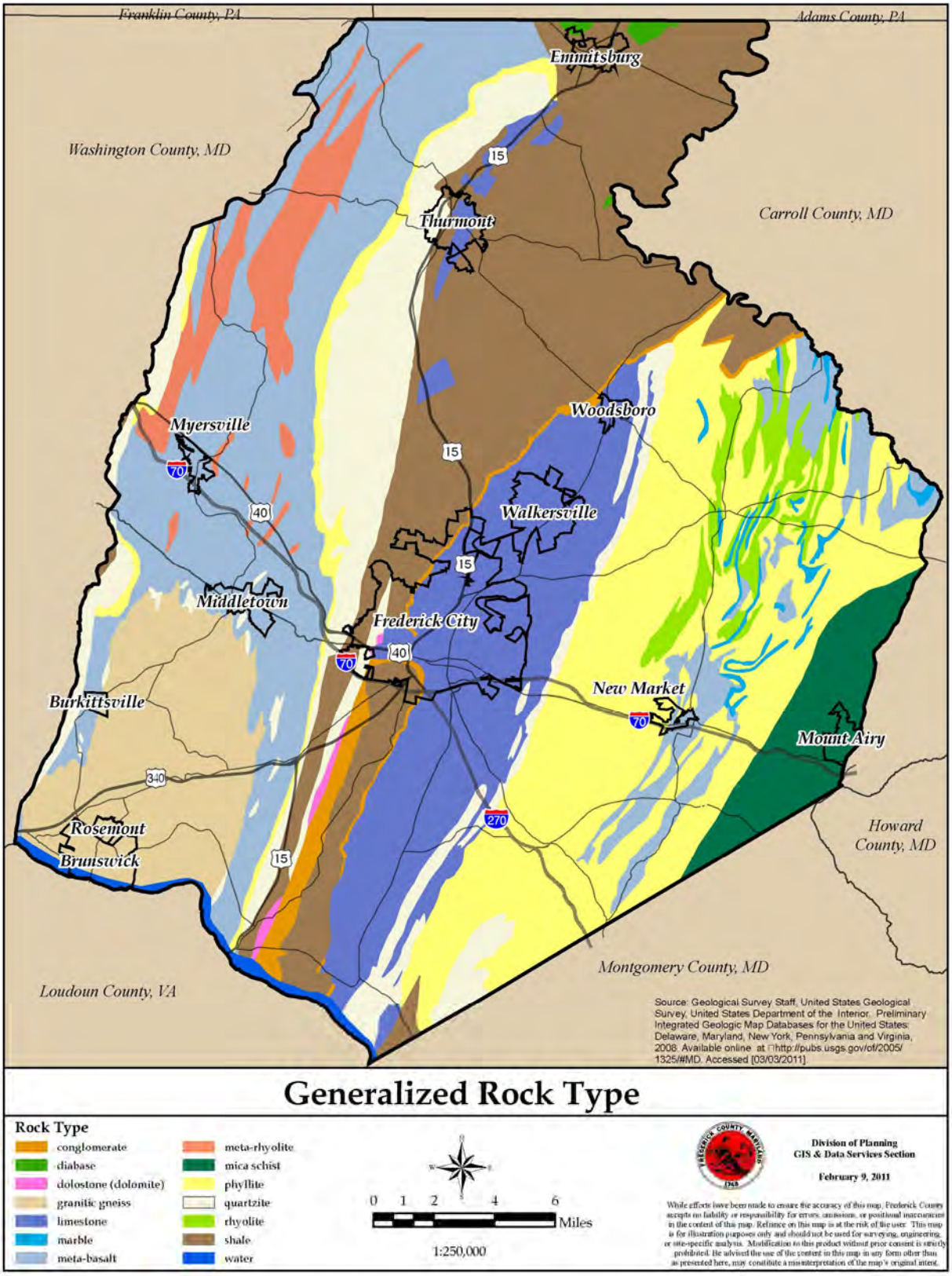


Figure C.6 Frederick County Generalized Rock Type

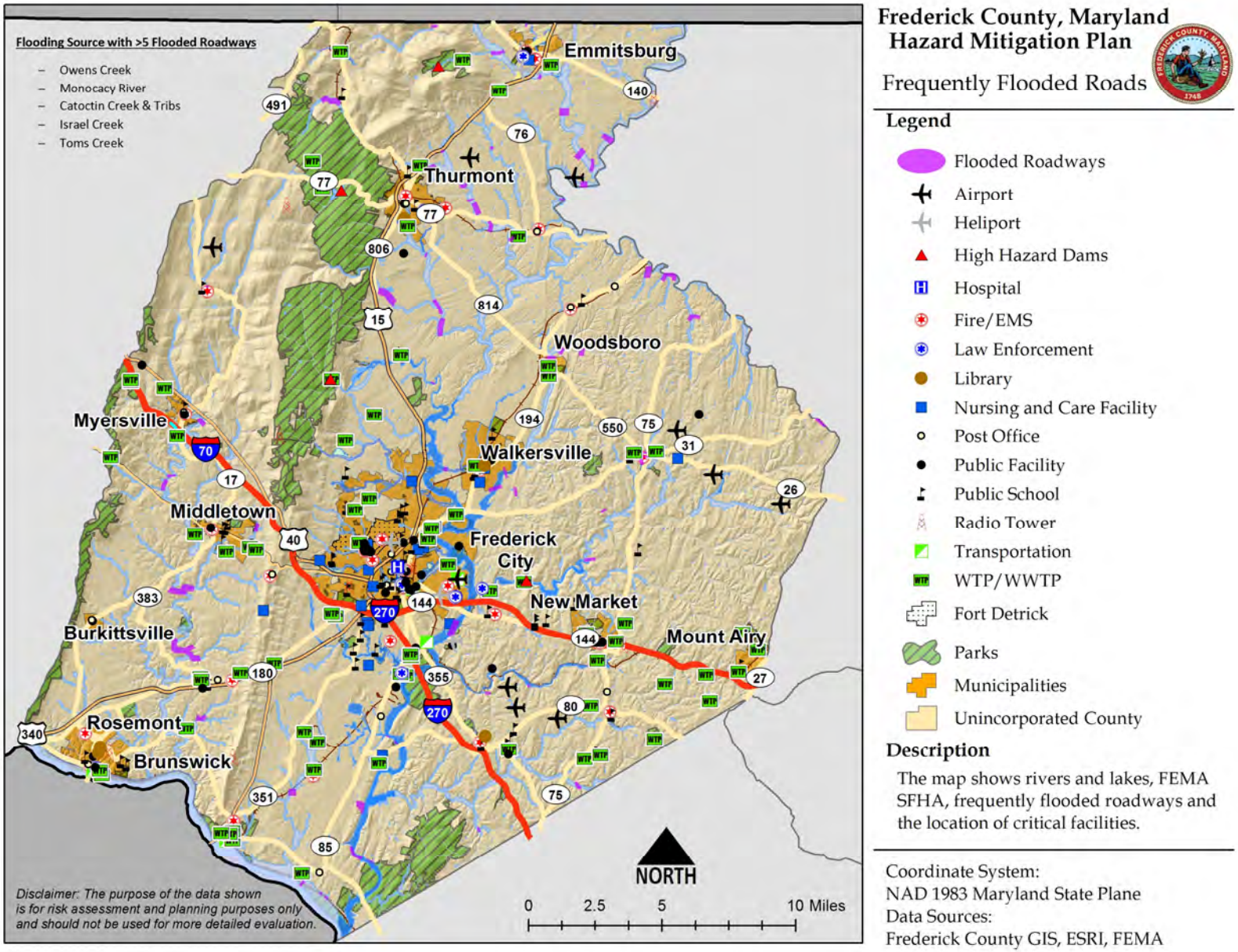


Figure C.7 Frederick County Frequently Flooded Roads

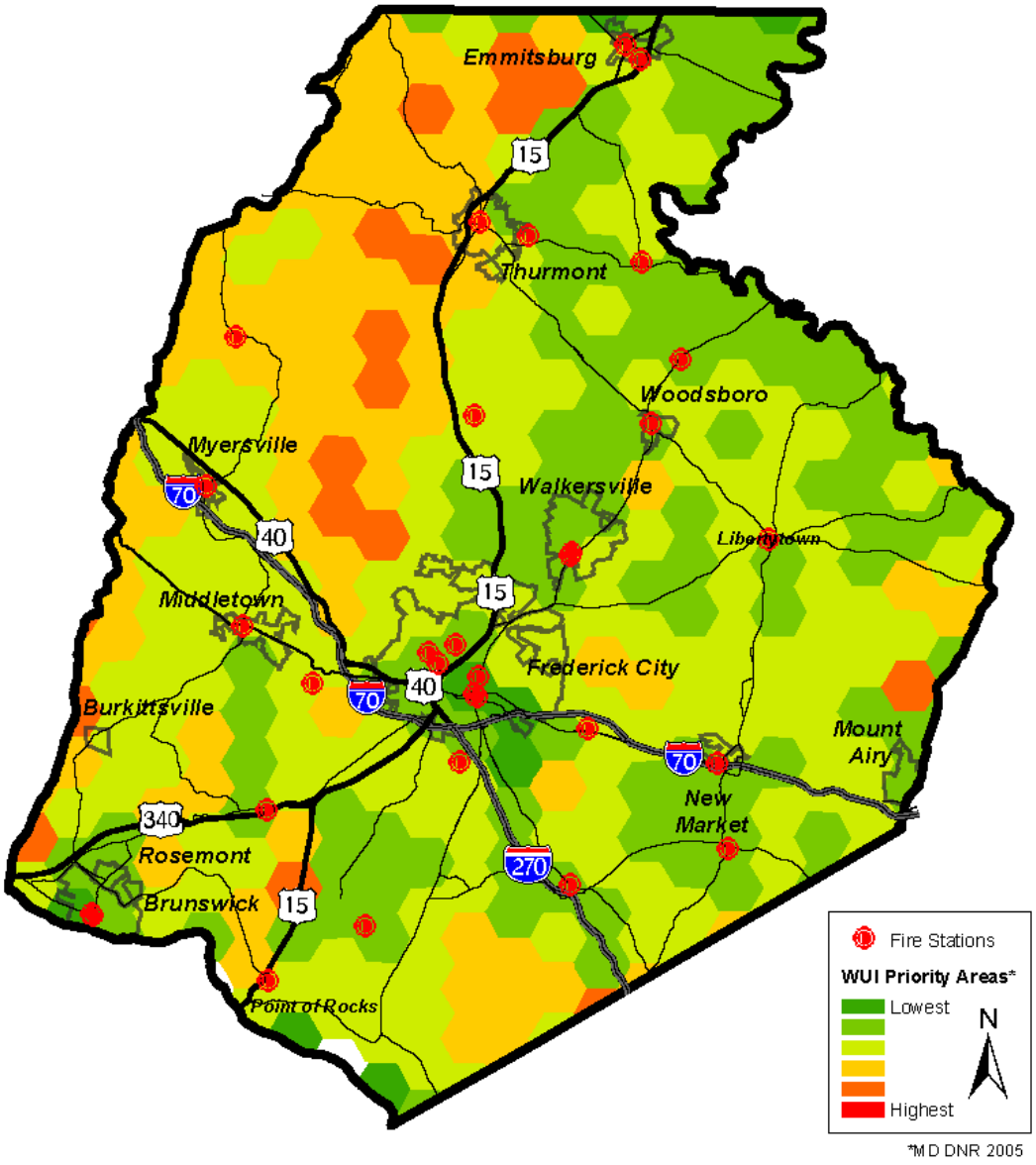


Figure C.8 Frederick County Fire Hazard Potential

Appendix D: Public Outreach Materials

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The Frederick News Post - December 6, 2015 - Page D6

PUBLIC NOTICES

NOTICE OF PUBLIC MEETING

The Frederick County Department of Emergency Preparedness is hosting a public meeting on Thursday, December 10, 2015, at 1:00 p.m. until 3:00 p.m. in the CBA Community Room at the C. Burr Artz Public Library, 110 E. Patrick St., Frederick, Maryland.

The Department of Emergency Preparedness staff will discuss Frederick County's Hazard Mitigation Plan update and educate the public on the planning process. For more information about the meeting please contact: 301-600-1746.

Individuals will be given an opportunity to be heard at this public meeting. Comments will be limited to five (5) minutes per speaker.

Persons requiring special accommodations for this public meeting are requested to contact the Department of Emergency Preparedness staff at 301-600-1746. (TTY: Use Maryland Relay) to make the necessary arrangements no later than three (3) business days prior to the meeting.

Frederick County Government does not discriminate on the basis of race, color, national origin, sex, religion, age or disability in employment or the provision of services.

Dec. 6, 8, 2015

FREDERICK COUNTY PARKS AND RECREATION DIVISION 355 MONTEVUE LANE, SUITE 100 FREDERICK, MD 21702

PUBLIC NOTICE

TO ALL PERSONS INTERESTED IN THE ESTATE OF Kenneth Lamar Renner, Sr.

Notice is given that Kenneth L. Renner, Jr., 8129A Stevens Road, Thurmont, MD 21788 was on 9/28/2015 appointed personal representative of the estate of Kenneth Lamar Renner, Sr. who died on 7/19/2015 a will.

Further information can be obtained by reviewing the estate file in the office of the Register of Wills or by contacting the personal representative or the attorney.

All persons having any objection to the appointment (or to the probate of the decedent's will) shall file their objections with the Register of Wills on or before the 28th day of March, 2016.

Any person having a claim against the decedent must present the claim to the undersigned personal representative or file it with the Register of Wills with the copy to the undersigned on or before the earlier of the following dates:

(1) Six months from the date of the decedent's death, except if the decedent died before October 1, 1992, nine months from the date of the decedent's death; or

(2) Two months after the personal representative mails or otherwise delivers to the creditor a copy of this published notice or other written notice, notifying the creditor that the claim will be barred unless the creditor presents the claims within two months from the mailing or other delivery of the notice. A claim not presented or filed on or before that date, or any extension provided by law, is unenforceable thereafter. Claim forms may be ob-

The Frederick News Post Sunday, December 13, 2015

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ceresvillemasonry@gmail.com

Autumn Breeze Massage Spa Come in for the most relaxing experience in Frederick. OurAsian therapists are skilled at making the stress melt away. This is the best of the best in relaxation
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LEAF CLEAN UP by Robin's Gardens Landscape design/planting, mulching, weeding, & organizing home, garage, office & files. **240-606-2778**

PAINTING: Interior & exterior custom painting. Free est lic & ins MHIC38177 **KNK PAINTING CO. 301-865-4883** Local Refs

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R. Wayne Kline Builder MHIC17886 All types of renovations & carpenter work. Additions, Basements, Replacement Windows, Doors, Siding, Decks, Kitchen, Bathrooms, and Painting. All types of repair work. Call 301-606-7819 for a free estimate.

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All types of work. Insured.
Call 301-748-7717

Select Home Exteriors, LLC ROOFING, SIDING, WINDOWS, GUTTERS & MORE! Residential Exterior Remodeling Company Specializing in: Full Roof Replacement Siding Windows Finish Basements Exterior Repairs Seamless Gutters & Gutter Protection Custom Decks Fences Financing Available & All Major credit cards accepted Licensed, Bonded & Insured MHIC#106434 Contact us for your FREE estimate today! 301-845-7470
www.selecthomeexteriors.com

PUBLIC NOTICES

NOTICE OF PUBLIC MEETING

The Frederick County Department of Emergency Preparedness is hosting a public meeting on **Thursday, December 17, 2015**, at 1:00 p.m. until 3:00 p.m. in the CBA Community Room at the C. Burr Artz Public Library, 110 E. Patrick St., Frederick, Maryland.

The Department of Emergency Preparedness staff will discuss Frederick County's Hazard Mitigation Plan final draft and review the significant changes from the 2009 plan. For more information about the meeting please contact: 301-600-1746.

Individuals will be given an opportunity to be heard at this public meeting. Comments will be limited to five (5) minutes per speaker.

Persons requiring special accommodations for this public meeting are requested to contact the Department of Emergency Preparedness staff at 301-600-1746. (TTY: Use Maryland Relay) to make the necessary arrangements no later than three (3) business days prior to the meeting.

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Dec 13, 15, 2015

FREDERICK COUNTY PARKS AND RECREATION DIVISION
355 MONTEVUE LANE, SUITE 100
FREDERICK, MD 21702

PUBLIC NOTICE

The Frederick County Parks and Recreation Division is seeking to lease for farming purposes approximately 15 acres of land in the Robin Meadows Subdivision off New Design Road, beginning January 1, 2016. Terms of the lease include mowing and noxious weed control, and other requirements as provided in bid packet (available at 355 Montevue Lane). Written proposals must include details and an offer of payment per acre per year, and must be received at the Parks Office at 355 Montevue Lane, Suite 100, Frederick, MD 21702 no later than close of business on December 16, 2015. Written award will be made to the proposal deemed to be in the best interest of the County. Please call 301-600-6640 for further information.

Dec 5, 6, 12, 13, 2015

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PUBLIC NOTICES

NOTICE OF PUBLIC MEETING

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Individuals will be given an opportunity to be heard at this public meeting. Comments will be limited to five (5) minutes per speaker.

Persons requiring special accommodations for this public meeting are requested to contact the Department of Emergency Preparedness staff at 301-600-1746. (TTY: Use Maryland Relay) to make the necessary arrangements no later than three (3) business days prior to the meeting.

Frederick County Government does not discriminate on the basis of race, color, national origin, sex, religion, age or disability in employment or the provision of services.

Dec 13, 15, 2015

ORDER OF NISI

Case Number: 10-C-15-001049 FC
Lender License Number: 1018

Jeffrey B Fisher

VS.

John Shultz III

NOTICE OF SALE

Notice is hereby issued by the Circuit Court for Frederick County this 4th day of December 2015, that the sale made and recorded by

described in these proceedings

1959 Crossing Stone Court
Frederick, MD 21702

be ratified and confirmed thirty (30) days from the date of this Notice, unless cause to the contrary be shown, provided a copy of this Notice be inserted in some Newspaper published in this County, once in each of three (3) successive weeks. The report states the amount of the sale to be $187,481.85.

Sandra K. Dalton
Clerk of the Circuit Court of Frederick County

Dec 8,. 15, 22, 2015

ORDER OF NISI

Case Number: 10-C-14-003339 FC
Lender License Number: N/A

Jeffrey B Fisher

VS.

Rahsaan O Hall
Lakisha L Hall

NOTICE OF SALE

Notice is hereby issued by the Circuit Court for Frederick County this 4th day of December 2015, that the sale made and recorded by

Jeffrey B. Fisher

for the sale of the property described in these proceedings

3571 Tabard Lane
Frederick, MD 21704

be ratified and confirmed thirty (30) days from the date of this Notice, unless cause to the contrary be shown, provided a copy of this Notice be inserted in some Newspaper published in this County, once in each of three (3) successive weeks. The report states the amount of the sale to be $336,700.00.

Sandra K. Dalton
Clerk of the Circuit Court of Frederick County

Dec 8, 15, 22, 2015

Case Number:

Sign In Sheets

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Hazard Mitigation Planning
Public Sign-In Sheet

Name	Address	Email
Frances Valentine	Frederick, MD	palaKika41@yahoo.com
Mike Young	Jefferson, MD	mikeyoung301@gmail.com
TRAVIS EDDINS	EDDINS.TRAVIS35@GMAIL.com	10208 WOODTHRUSH DRIVE

Hazard Mitigation Planning
Public Sign-In Sheet

Name	Address	Email
William Zeh	809 Apache ct	

Presentation

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Frederick County
Hazard Mitigation Plan Update

November 2015

Historic Hazard Events in Frederick County

Hazards Type	Period of Record	Total Events	Expected Number of Annual Events	Property Damage (2015$)	Crop Damage (2015$)
Atmospheric Hazards					
Extreme Heat	1993 - 2015 NCDC	34	1.48	$0	$0
Extreme Wind	1993 - 2015 NCDC	48	2.09	$704,023	$130,589
Thunderstorm	1950 - 2015 NCDC	341	5.17	$3,805,851	$103,067
Hailstorms	1950 - 2015 NCDC	64	0.97	$5,495	$19,235
Lightning	1993 - 2015 NCDC	23	1.00	$1,164,012	$0
Severe Winter Weather	1993 - 2015 NCDC	149	6.48	$365,170	$21,774
	2010 - 2015 DPW	-	-	$11,711,682	$0
Tornado	1950 - 2015 NCDC	35	0.53	$5,110,661	$75,400
	2010 - 2015 DPW	-	-	$13,831	$0
Tropical Storm/Hurricane	1993 - 2015 NCDC	7	0.30	$5,259	$0
	2010 - 2015 DPW			$387,522	$0

Historic Hazard Events in Frederick County (cont.)

Hazards Type	Period of Record	Total Events	Expected Number of Annual Events	Property Damage (2015$)	Crop Damage (2015$)
Hydrological Hazards					
Drought	1993 - 2015 NCDC	12	0.52	$0	$36,139,325
Flooding	1993 - 2015 NCDC	136	5.91	$32,878,245	$60,320
	2010 - 2015 DPW	-	-	$349,446	$0
Dam Failure	USACE	0	0	$0	$0
Wildfire Hazards					
Wildfire/Wildland	2010 - 2015 AMS	94	18.8	$0	$0
Urban Interface	1998 - 2010 DNR	382	0	$0	$18,882
Geological Hazards					
Earthquake	USGS	0	0	$0	$0
Landslide	USGS	0	0	$0	$0
Karst/Sinkhole	2004 - 2015 DPW	300	27.3	$210,086	0
Total		1,625		$56,711,283	$36,568,592

Hazard Ranking

Hazards Type	Probability/History	Vulnerability	Maximum Threat (Geographic Area Affected)	Warning Time	2009 Priority Level	2016 Priority Level
Atmospheric Hazards						
Extreme Heat	Highly Likely	Negligible	Large	Extended	Low	Medium-High
Extreme Wind	Highly Likely	Limited	Small	Minimal	High	Medium-High
Thunderstorm	Highly Likely	Negligible	Small	Minimal	High	Medium
Hailstorms	Likely	Limited	Small	Minimal	Medium	Medium
Lightning	Highly Likely	Negligible	Isolated	Minimal	Medium	Medium
Severe Winter Weather	Highly Likely	Critical	Large	Limited	High	High
Tornado	Likely	Negligible	Isolated	No Notice	High	Medium
Tropical Storm/Hurricane	Somewhat Likely	Limited	Medium	Extended	Medium	Medium-Low
Hydrological Hazards						
Drought	Likely	Negligible	Medium	Extended	Medium	Medium
Flooding	Highly Likely	Critical	Small	Limited	High	High
Dam and Levee Failure	Unlikely	Negligible	Small	No Notice	Low	Low
Wildfire Hazards						
Wildfire/WUI	Highly Likely	Negligible	Small	No Notice	Medium	Medium-High
Geological Hazards						
Earthquake	Unlikely	Limited	Small	No Notice	Low	Medium-Low
Landslide	Unlikely	Limited	Small	No Notice	Low	Medium-Low
Karst/Land Subsidence	Highly Likely	Negligible	Isolated	No Notice	High	Medium

Climate Change

- Temperatures across the region increased on average 0.16°F per decade between 1895 and 2011
- Average temperatures in the Frederick County region
  - 2.5-4.5°F warmer by the middle of the century (2041-2070)
  - 3.5-7.5°F warmer by the latter part of the century (2071-2099)
  - Average of 15-18 more days annually above 95°F by the middle of the 21st Century (2041-2070)
- Annual precipitation changes will be felt during both summer and winter seasons
  - Heavier precipitation occurring in the winter
  - Longer and dryer summer seasons occurring with decreased rainfall
  - 18-21% increase in the annual number of days with >1 inch of precipitation by the middle of the 21st Century

Mitigation Plan Goals

- GOAL 1: Promote public understanding, support, and involvement in hazard mitigation activities.
- GOAL 2: Reduce exposure to natural hazards through local planning and ordinances.
- GOAL 3: Reduce Frederick County's vulnerability to sinkholes.
- GOAL 4: Investigate structural solutions to flooding problems.
- GOAL 5: Develop measures to protect all buildings (commercial, residential, institutional, and industrial) that are in the floodplain.

Mitigation Plan Goals

- GOAL 6: Reduce the risk of wildland and urban interface wildfires in the county.
- GOAL 7: Ensure safe and efficient evacuation routes within, to, and from Frederick County.
- GOAL 8: Provide adequate multi-hazard shelters.
- GOAL 9: Improve severe weather notification within the county.
- GOAL 10: Identify community-specific needs to reduce risks to various hazards.

Survey

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2015 Frederick County Hazard Mitigation Plan Survey

Frederick County and its municipalities are currently updating the Frederick County Hazard Mitigation Plan (last completed in 2011) and welcome your input. Your thoughts on natural hazard risk and mitigation are a critical component in developing an effective countywide mitigation strategy. With your input, Frederick County and its municipalities will continue to build upon and improve the hazard mitigation strategy and keep the county and municipalities qualified for FEMA Hazard Mitigation Assistance funding. We know you are busy and respectfully request a few moments of your time to respond to the brief survey below.

The survey is expected to take 5-10 minutes to complete. You can also complete this survey on-line at https://www.surveymonkey.com/r/RVMXHRZ

Thank you for taking the time to complete this survey. If you have any questions regarding this survey you may contact Seamus Mooney at SMooney@FrederickCountyMD.gov.

1. Please select the jurisdiction in which you live:

- ○ Frederick County
- ○ Brunswick
- ○ Burkittsville
- ○ Emmitsburg
- ○ Frederick (City of)
- ○ Middletown
- ○ Mt. Airy
- ○ Myersville
- ○ New Market
- ○ Rosemont
- ○ Thurmont
- ○ Woodsboro
- ○ Walkersville
- ○ Other (please specify)

2. What is your zip code?

3. Please rate each of the following hazards on a scale of 1 (low) to 5 (high) indicating the level of threat each presents to your neighborhood or home. (leave rating blank for hazards that are not applicable)

	Low	Medium-Low	Medium	Medium-High	High
Extreme Heat	○	○	○	○	○
Extreme Wind	○	○	○	○	○
Thunderstorm	○	○	○	○	○
Hailstorms	○	○	○	○	○
Lightning	○	○	○	○	○
Severe Winter Weather	○	○	○	○	○
Tornado	○	○	○	○	○
Tropical Storm/Hurricane	○	○	○	○	○
Drought	○	○	○	○	○
Flooding	○	○	○	○	○
Dam and Levee Failure	○	○	○	○	○
Wildfire	○	○	○	○	○
Earthquake	○	○	○	○	○
Landslide	○	○	○	○	○
Karst/Land Subsidence	○	○	○	○	○

Other (please specify)

4. Which hazard poses the greatest risk to Frederick County and its municipalities?

5. If you are a homeowner, do you have adequate basic homeowners insurance to cover the hazards that could impact your home?

- ◯ Yes, my insurance coverage should be adequate
- ◯ No, I don't believe my insurance coverage would be adequate for a major disaster
- ◯ Unsure
- ◯ I do not have an insurance policy
- ◯ Not applicable, I rent my current residence

6. Do you have any other insurance? (e.g., flood, subsidence, etc.)

- ◯ Yes
- ◯ No
- ◯ I don't know

7. Did you know that most standard homeowner's insurance policies do not cover rising water (flooding) or minor subsidence (sinkhole)?

- ◯ Yes
- ◯ No

8. If you are a homeowner and a disaster substantially damaged your home, which of the following would be the most likely option you would pursue?

- ◯ Repair/rebuild in the same location to current building code standards
- ◯ Sell my home/property and relocate
- ◯ Not sure
- ◯ Not applicable, I rent my current residence

9. Are you aware that you would have to comply with current local/state codes, ordinances, and laws that would affect rebuilding and recovery in the wake of a disaster?

- ◯ Yes
- ◯ No

10. What have you done to reduce risk of damage from natural and human-caused hazards? (choose all that apply)

- [ ] Purchased optional flood insurance
- [ ] Purchased enhanced homeowner insurance coverage (sinkhole, additional wind coverage)
- [ ] Installed backflow prevention device(s) (to prevent sewer back-ups)
- [ ] Elevated first floor of home
- [ ] Elevated appliances (i.e., hot water heater) or mechanical systems (i.e., air conditioning)
- [ ] Purchased generator for home
- [ ] Implemented defensible space landscaping (clear vegetation around house to reduce wildfire risk)
- [ ] Retrofitted roof (e.g., fire resistant shingles, hurricane brackets, etc)
- [ ] Strengthened openings (e.g., doors, windows, and/or garage door to reduce high-hazard wind risk)

Other (please specify)

11. Have you signed up for the ALERT Frederick County emergency notification system?

- ( ) Yes
- ( ) No
- ( ) I don't know what that is
- ( ) Other (please specify)

12. Do you work in Frederick County?

- ◯ Yes
- ◯ No

If yes, please provide your workplace zip code. If no, please skip to #13.

13. Does your employer have a plan for disaster recovery in place?

- ◯ Yes
- ◯ No
- ◯ I don't know

14. Does your employer have a means of getting in touch with you following a disaster?

- ◯ Yes
- ◯ No
- ◯ I don't know

15. What one action could Frederick County and/or its municipalities take to reduce the long-term impact of disasters to the community?

16. Please provide us with any additional comments/suggestions that you have regarding natural disasters and the Frederick County Hazard Mitigation Plan.

Survey Results

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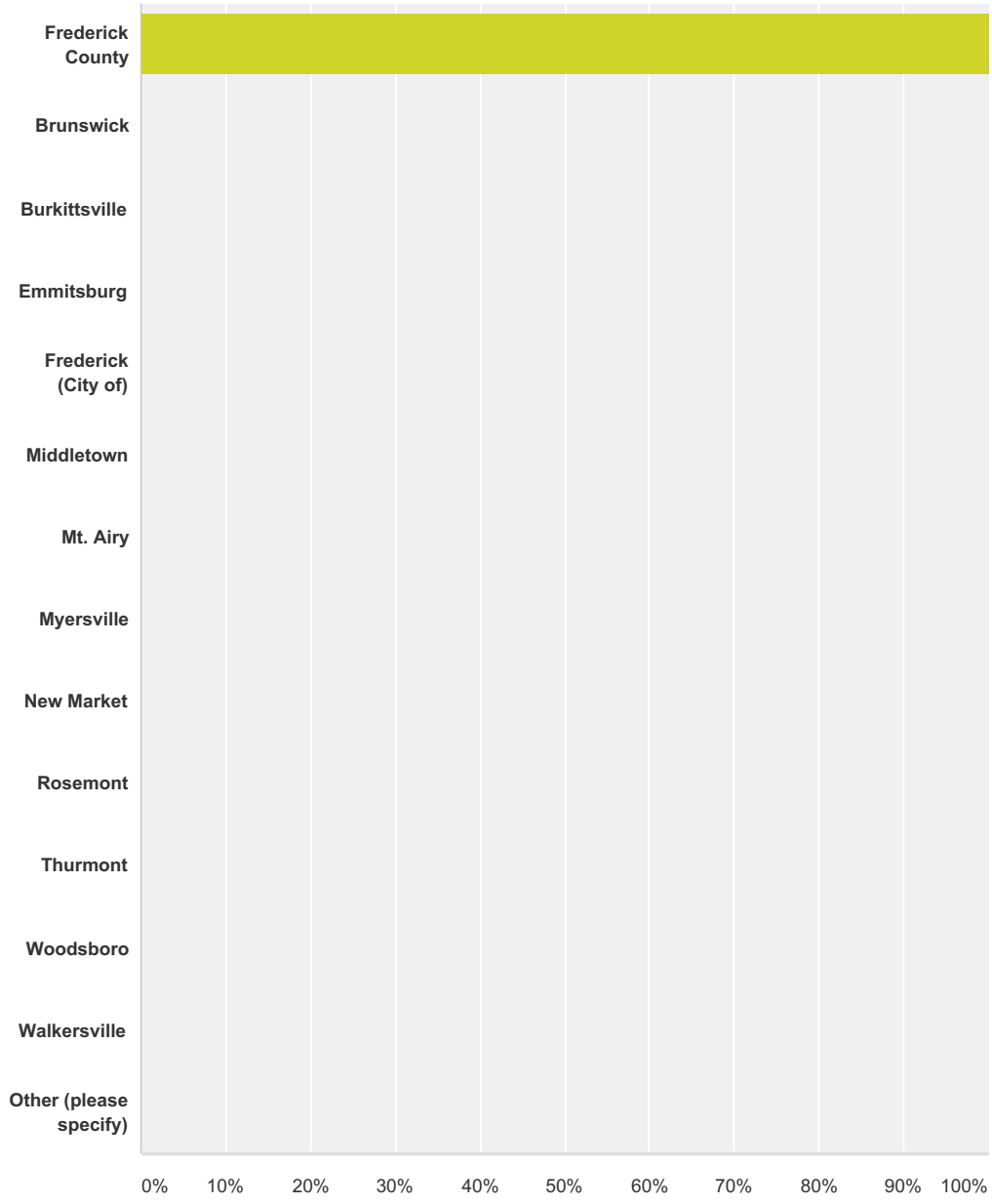
Q1 Please select the jurisdiction in which you live:

Answered: 1 Skipped: 1



Answer Choices	Responses	
Frederick County	**100.00%**	1
Brunswick	**0.00%**	0
Burkittsville	**0.00%**	0
Emmitsburg	**0.00%**	0
Frederick (City of)	**0.00%**	0

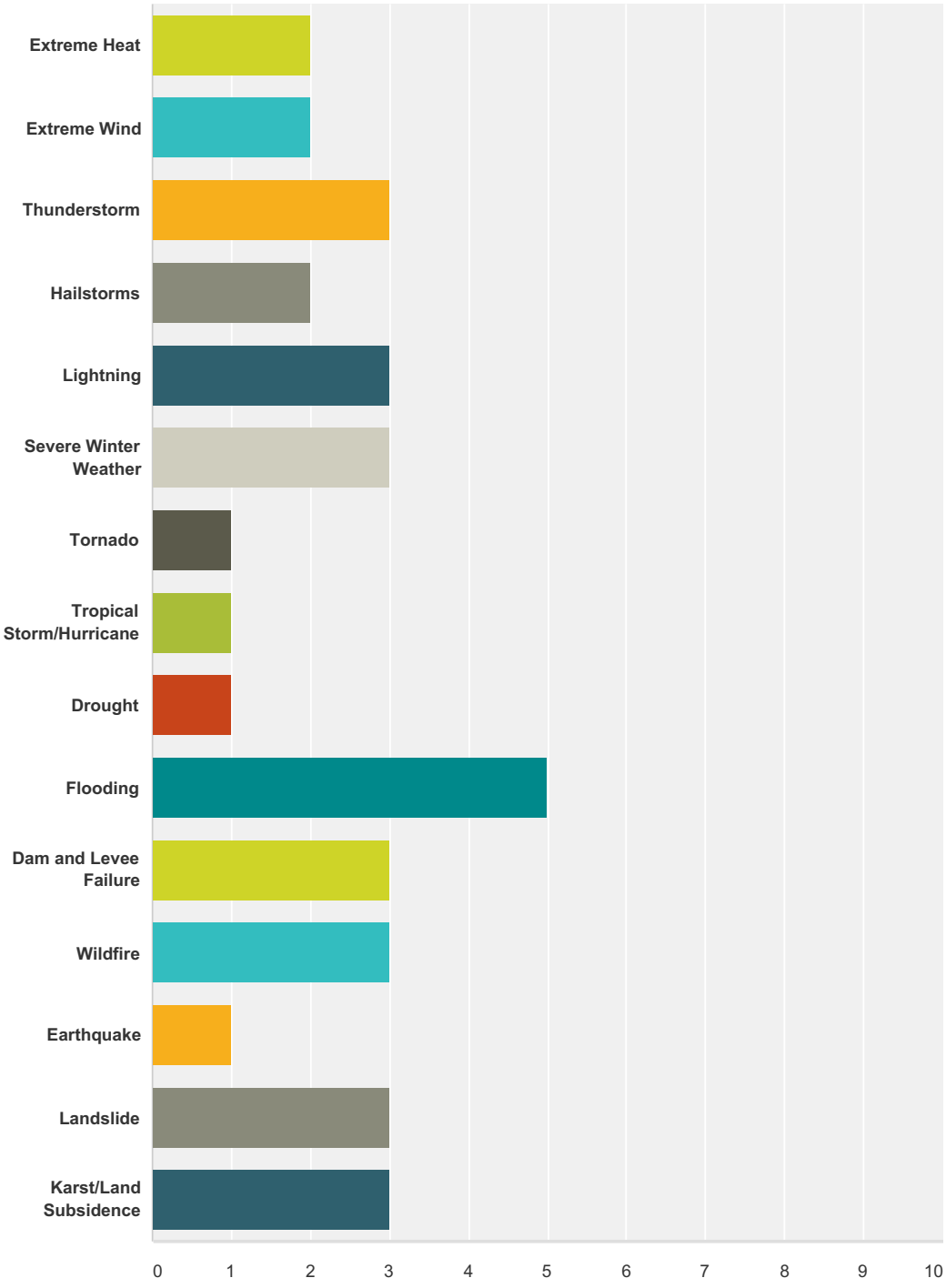
Middletown	**0.00%**	0
Mt. Airy	**0.00%**	0
Myersville	**0.00%**	0
New Market	**0.00%**	0
Rosemont	**0.00%**	0
Thurmont	**0.00%**	0
Woodsboro	**0.00%**	0
Walkersville	**0.00%**	0
Other (please specify)	**0.00%**	0
Total		**1**

Q2 What is your zip code?

Answered: 1 Skipped: 1

Q3 Please rate each of the following hazards on a scale of 1 (low) to 5 (high) indicating the level of threat each presents to your neighborhood or home. (leave rating blank for hazards that are not applicable)

Answered: 1 Skipped: 1

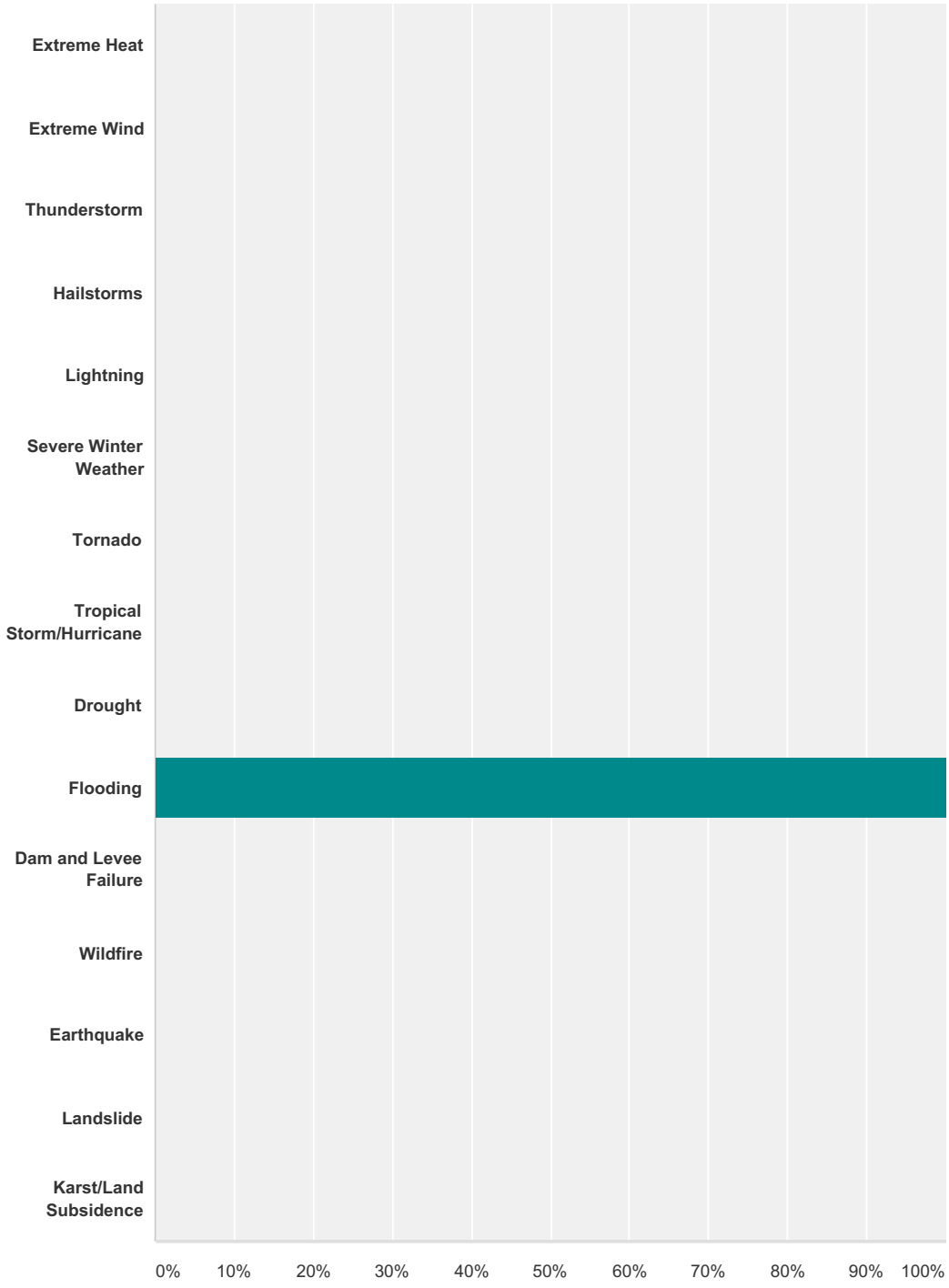


	Low	Medium-Low	Medium	Medium-High	High	Total	Weighted Average
Extreme Heat	0.00% 0	100.00% 1	0.00% 0	0.00% 0	0.00% 0	1	2.00
Extreme Wind	0.00% 0	100.00% 1	0.00% 0	0.00% 0	0.00% 0	1	2.00
Thunderstorm	0.00% 0	0.00% 0	100.00% 1	0.00% 0	0.00% 0	1	3.00
Hailstorms	0.00% 0	100.00% 1	0.00% 0	0.00% 0	0.00% 0	1	2.00

Lightning	**0.00%** 0	**0.00%** 0	**100.00%** 1	**0.00%** 0	**0.00%** 0	1	3.00
Severe Winter Weather	**0.00%** 0	**0.00%** 0	**100.00%** 1	**0.00%** 0	**0.00%** 0	1	3.00
Tornado	**100.00%** 1	**0.00%** 0	**0.00%** 0	**0.00%** 0	**0.00%** 0	1	1.00
Tropical Storm/Hurricane	**100.00%** 1	**0.00%** 0	**0.00%** 0	**0.00%** 0	**0.00%** 0	1	1.00
Drought	**100.00%** 1	**0.00%** 0	**0.00%** 0	**0.00%** 0	**0.00%** 0	1	1.00
Flooding	**0.00%** 0	**0.00%** 0	**0.00%** 0	**0.00%** 0	**100.00%** 1	1	5.00
Dam and Levee Failure	**0.00%** 0	**0.00%** 0	**100.00%** 1	**0.00%** 0	**0.00%** 0	1	3.00
Wildfire	**0.00%** 0	**0.00%** 0	**100.00%** 1	**0.00%** 0	**0.00%** 0	1	3.00
Earthquake	**100.00%** 1	**0.00%** 0	**0.00%** 0	**0.00%** 0	**0.00%** 0	1	1.00
Landslide	**0.00%** 0	**0.00%** 0	**100.00%** 1	**0.00%** 0	**0.00%** 0	1	3.00
Karst/Land Subsidence	**0.00%** 0	**0.00%** 0	**100.00%** 1	**0.00%** 0	**0.00%** 0	1	3.00

Q4 Which hazard poses the greatest risk to Frederick County and its municipalities?

Answered: 1 Skipped: 1

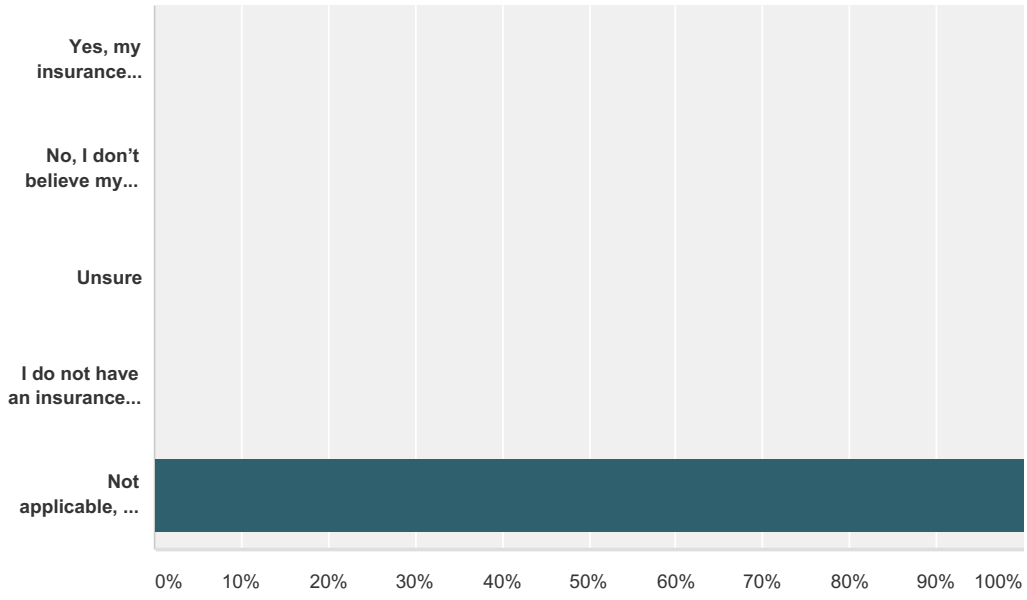


Answer Choices	Responses	
Extreme Heat	**0.00%**	0
Extreme Wind	**0.00%**	0
Thunderstorm	**0.00%**	0
Hailstorms	**0.00%**	0
Lightning	**0.00%**	0
Severe Winter Weather	**0.00%**	0

Tornado	**0.00%**	0
Tropical Storm/Hurricane	**0.00%**	0
Drought	**0.00%**	0
Flooding	**100.00%**	1
Dam and Levee Failure	**0.00%**	0
Wildfire	**0.00%**	0
Earthquake	**0.00%**	0
Landslide	**0.00%**	0
Karst/Land Subsidence	**0.00%**	0
Total		**1**

Q5 If you are a homeowner, do you have adequate basic homeowners insurance to cover the hazards that could impact your home?

Answered: 1 Skipped: 1



Answer Choices	Responses	
Yes, my insurance coverage should be adequate	**0.00%**	0
No, I don't believe my insurance coverage would be adequate for a major disaster	**0.00%**	0
Unsure	**0.00%**	0
I do not have an insurance policy	**0.00%**	0
Not applicable, I rent my current residence	**100.00%**	1
Total		**1**

Q6 Do you have any other insurance? (e.g., flood, subsidence, etc.)

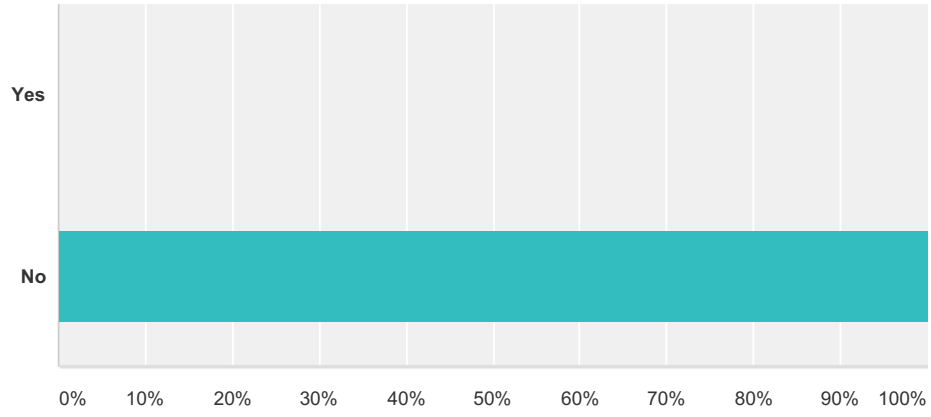
Answered: 0 Skipped: 2

! No matching responses.

Answer Choices	Responses	
Yes	0.00%	0
No	0.00%	0
I don't know	0.00%	0
Total		0

Q7 Did you know that most standard homeowner's insurance policies do not cover rising water (flooding) or minor subsidence (sinkhole)?

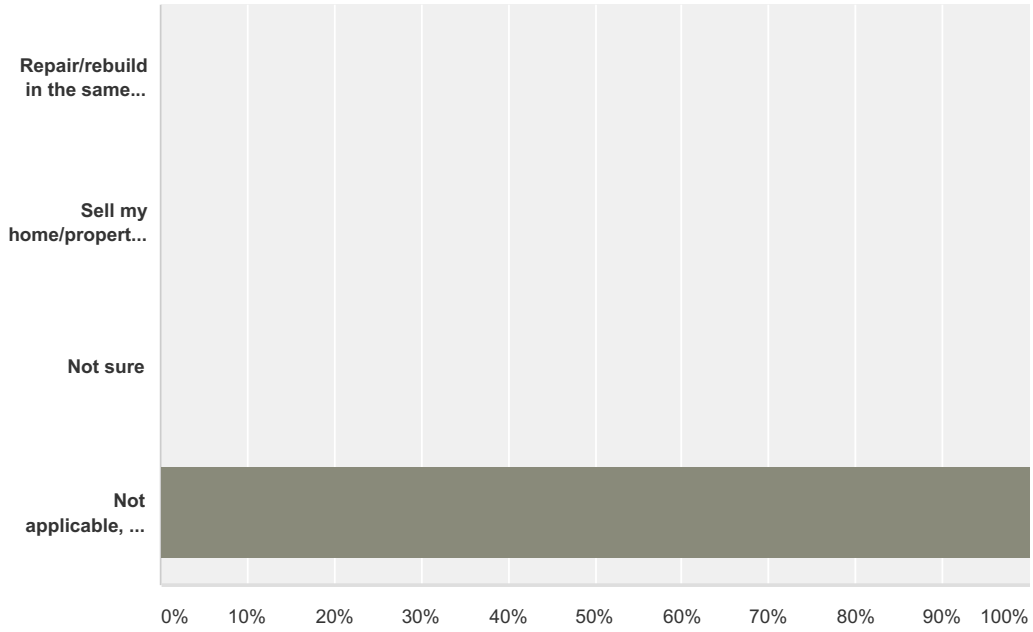
Answered: 1 Skipped: 1



Answer Choices	Responses	
Yes	0.00%	0
No	100.00%	1
Total		1

Q8 If you are a homeowner and a disaster substantially damaged your home, which of the following would be the most likely option you would pursue?

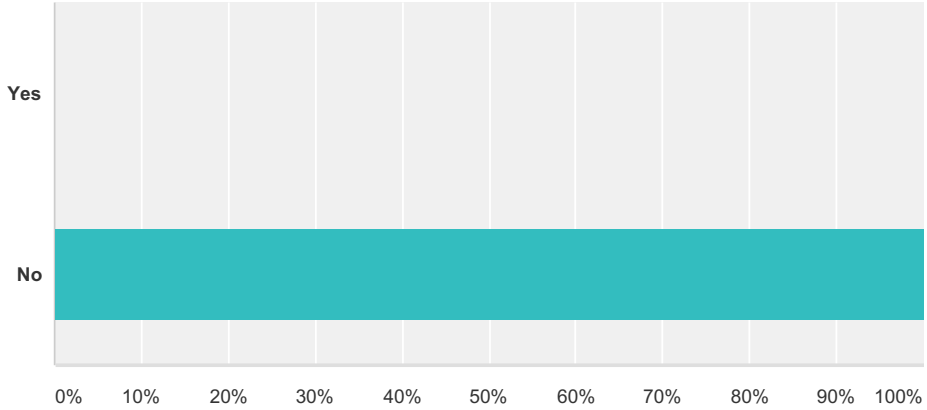
Answered: 1 Skipped: 1



Answer Choices	Responses	
Repair/rebuild in the same location to current building code standards	**0.00%**	0
Sell my home/property and relocate	**0.00%**	0
Not sure	**0.00%**	0
Not applicable, I rent my current residence	**100.00%**	1
Total		**1**

Q9 Are you aware that you would have to comply with current local/state codes, ordinances, and laws that would affect rebuilding and recovery in the wake of a disaster?

Answered: 1 Skipped: 1



Answer Choices	Responses	
Yes	0.00%	0
No	100.00%	1
Total		1

Q10 What have you done to reduce risk of damage from natural and human-caused hazards? (choose all that apply)

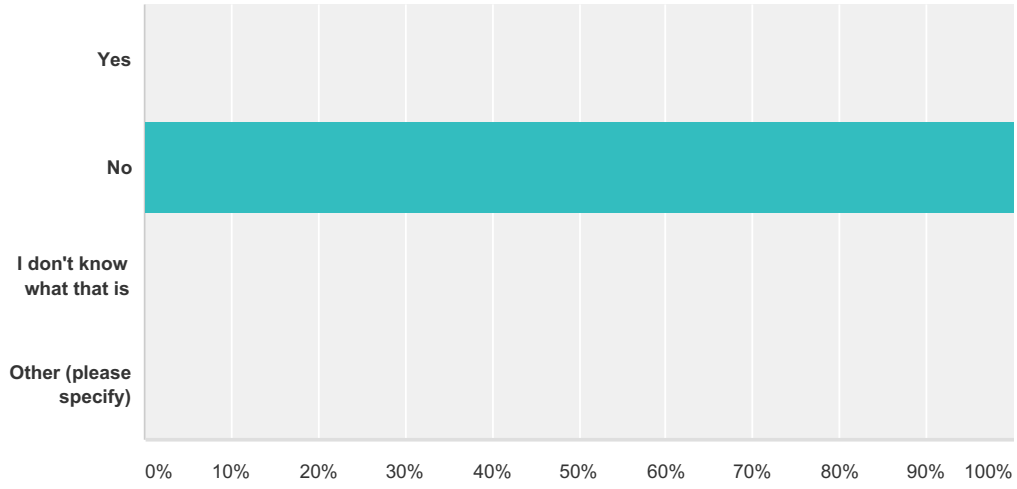
Answered: 0 Skipped: 2

! No matching responses.

Answer Choices	Responses	
Purchased optional flood insurance	0.00%	0
Purchased enhanced homeowner insurance coverage (sinkhole, additional wind coverage)	0.00%	0
Installed backflow prevention device(s) (to prevent sewer back-ups)	0.00%	0
Elevated first floor of home	0.00%	0
Elevated appliances (i.e., hot water heater) or mechanical systems (i.e., air conditioning)	0.00%	0
Purchased generator for home	0.00%	0
Implemented defensible space landscaping (clear vegetation around house to reduce wildfire risk)	0.00%	0
Retrofitted roof (e.g., fire resistant shingles, hurricane brackets, etc)	0.00%	0
Strengthened openings (e.g., doors, windows, and/or garage door to reduce high-hazard wind risk)	0.00%	0
Total Respondents: 0		

Q11 Have you signed up for the ALERT Frederick County emergency notification system?

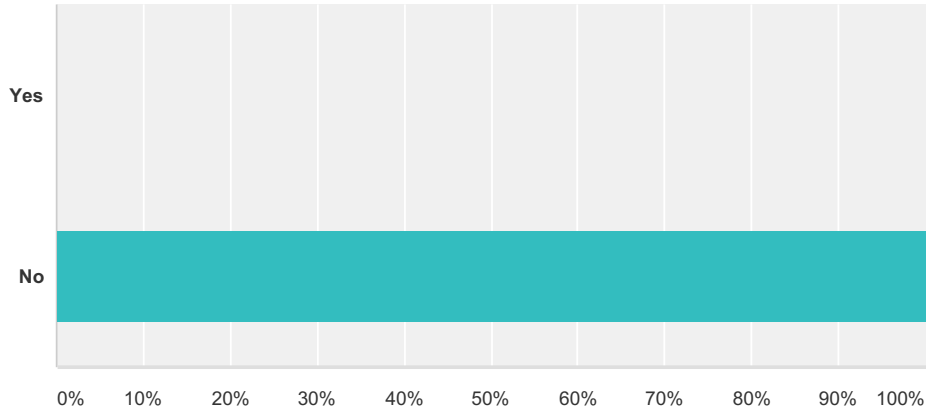
Answered: 1 Skipped: 1



Answer Choices	Responses	
Yes	**0.00%**	0
No	**100.00%**	1
I don't know what that is	**0.00%**	0
Other (please specify)	**0.00%**	0
Total		**1**

Q12 Do you work in Frederick County?

Answered: 2 Skipped: 0



Answer Choices	Responses	
Yes	**0.00%**	0
No	**100.00%**	2
Total		**2**

Q13 Does your employer have a plan for disaster recovery in place?

Answered: 0 Skipped: 2

! No matching responses.

Answer Choices	Responses	
Yes	0.00%	0
No	0.00%	0
I don't know	0.00%	0
Total		0

Q14 Does your employer have a means of getting in touch with you following a disaster?

Answered: 0 Skipped: 2

! No matching responses.

Answer Choices	Responses	
Yes	0.00%	0
No	0.00%	0
I don't know	0.00%	0
Total		0

Q15 What one action could Frederick County and/or its municipalities take to reduce the long-term impact of disasters to the community?

Answered: 1 Skipped: 1

Q16 Please provide us with any additional comments/suggestions that you have regarding natural disasters and the Frederick County Hazard Mitigation Plan.

Answered: 1 Skipped: 1

REFERENCES

[1] Frederick County. Office of Economic Development. Retrieved from http://www.discoverfrederickmd.com/business_support/major_employers on Janaury 18, 2016.
[2] *2010 Frederick County Comprehensive Plan.*
[3] *Frederick County Water & Sewerage Plan, effective June 2, 2015.* Retrieved from http://frederickcountymd.gov/DocumentCenter/View/283649.
[4] FEMA. *FEMA's Mitigation Directorate Fact Sheet*. Spring/Summer 2008.
[5] FEMA National Emergency Management Information System (NEMIS) (as of August 2015).
[6] http://www.nytimes.com/2002/04/21/nyregion/extended-drought-strains-resources-along-east-coast.html
[7] NOAA NCDC Storm Events Database (as of May 2015).
[8] Nese, Jon M. and Grenci, Lee M. Kendall/Hunt.*A World of Weather, Third Edition.* Penn State Meteorology.
[9] American Red Cross.*Talking About Disaster: Guide for Standard Messages*.
[10] Federal Emergency Management Agency. *FEMA RiskMAP Monocacy Watershed Discovery Report.* September 2014.
[11] *Maryland State Hazard Mitigation Plan.* 2011.
[12] Federal Emergency Management Agency. *Why Dams Fail.* http://www.fema.gov/hazard/damfailure/why.shtm
[13] Maryland Department of the Environment. *Facts About Maryland's Dam Safety Program.* http://www.mde.state.md.us/assets/document/damsafety/DamSafetyFactSheet.pdf
[14] "Gov. Blunt Announces $180 Million Settlement Between State and Ameren for Taum Sauk Reservoir Disaster." Office of Missouri Governor Matt Blunt. 28 November 2007. http://governor.mo.gov/cgi-bin/coranto/viewnews.cgi?id=EEAykyuAEuKxAtvRow&style=Default+News+Style&tmpl=newsitem
[15] Yochum, Steven E., Larry Goertz, and Phillip Jones. *Case Study of the Big Bay Dam Failure: Accuracy and Comparison of Breach Predictions.* Journal of Hydraulic Engineering, Volunteer. 134, No. 9. September 2008, pp. 1285-1293. http://dx.doi.org/10.1061/(ASCE)0733-9429(2008)134:9(1285)
[16] Town of Estes Park, Colorado.*Lawn Lake Dam Failure….Summary Version.* http://www.estesnet.com/82flood/Lawn%20Lake%20Summary.aspx
[17] Federal Emergency Management Agency. *Why Dams Fail.* http://www.fema.gov/hazard/damfailure/why.shtm
[18] Petersen, M.D., Moschetti, M.P., Powers, P.M., Mueller, C.S., Haller, K.M., Frankel, A.D., Zeng, Yuehua, Rezaeian, Sanaz, Harmsen, S.C., Boyd, O.S., Field, Ned, Chen, Rui, Rukstales, K.S., Luco, Nico, Wheeler, R.L., Williams, R.A., and Olsen, A.H., 2014, Documentation for the 2014 update of the United States national seismic hazard maps: U.S. Geological Survey Open-File Report 2014–1091, 243 p., http://dx.doi.org/10.3133/ofr20141091.
[19] Maryland Geologic Survey. *Earthquakes and Maryland.* http://www.mgs.md.gov/documents/mdquakes03.pdf Last date from 2011.
[20] Maryland Geologic Survey. *Earthquakes and Maryland.* http://www.mgs.md.gov/geology/geohazards/earthquakes_and_maryland.html accessed August 2015.
[21] "3.6-Magnitude Earthquake Shakes D.C. Region." NBC4. http://www.nbcwashington.com/news/local/36-Magnitude-Earthquake-Shakes-DC-Region-98589124.html.
[22] Maryland Geologic Survey. *Earthquakes and Maryland.* http://www.mgs.md.gov/documents/mdquakes03.pdf Last date from 2011.
[23] Maryland Geologic Survey. *Earthquakes and Maryland.* http://www.mgs.md.gov/documents/mdquakes03.pdf Last date from 2011.
[24] http://landslides.usgs.gov/learning/nationalmap/ Accessed January 6, 2009.
[25] Maryland Department of the Environment, Mining Program.
[26] David K. Brezinski and James P. Reger. *Stratigraphy-Karst Relationships in the Frederick Valley of Maryland.* Maryland Geologic Survey.
[27] United States Geological Survey. *Land Subsidence in the United States.* USGS Fact Sheet 165-00. December 2000. http://water.usgs.gov/ogw/pubs/fs00165/SubsidenceFS.v7.PDF

[28] Frederick County Division of Public Works. *Budget and Costs.* August 2015.
[29] Center for Science in the Earth System, *et al*. *Preparing for Climate Change. A Regional Guidebook for Local, Regional and State Governments*. September 2007.
[30] American Planning Association*. Policy Guide on Planning and Climate Change*. April 27, 2008.
[31] Center for Science in the Earth System (The Climate Impacts Group). *Preparing for Climate Change. A Guidebook for Local, Regional, and State Governments*. September 2007.
[32] http://www.mdclimatechange.us/ Accessed November 18, 2008.
[33] Maryland Department of the Environment. *2011 Greenhouse Gas Emissions Reduction Act of 2009 (GGRA) Draft Plan.* http://www.mde.state.md.us/programs/air/climatechange/pages/air/climatechange/index.aspx Accessed August 5, 2015.
[34] Frederick County. *Managing Climate Change.* https://frederickcountymd.gov/4347/Managing-Climate-Change Accessed August 5, 2015.
[35] Maryland Department of Natural Resources. *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change.* http://www.dnr.maryland.gov/climatechange/pdfs/climatechange_phase2_adaptation_strategy.pdf Accessed August 6, 2015.
[36] Center for Science in the Earth System (The Climate Impacts Group). *Preparing for Climate Change. A Guidebook for Local, Regional, and State Governments*. September 2007.
[37] Metropolitan Washington Council of Governments Climate Change Steering Committee. *National Capital Region's Climate Change Report.* Pg 27. November 12, 2008.
[38] http://www.epa.gov/climatechange/effects/water/ Accessed November 25, 2008.
[39] Richard M. Adams and Dannele E. Peck. Effects of Climate Change on Water Resources. 2008
[40] Maryland Department of Natural Resources. *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change.* http://www.dnr.maryland.gov/climatechange/pdfs/climatechange_phase2_adaptation_strategy.pdf Accessed August 6, 2015.
[41] http://www.usatoday.com/weather/climate/globalwarming/2008-08-07-heavy-precipitation_N.htm Accessed December 18, 2008
[42] Maryland Commission on Climate Change. *Comprehensive Assessment of Climate Change Impacts in Maryland.* July 2008.
[43] Maryland Commission on Climate Change. *Comprehensive Assessment of Climate Change Impacts in Maryland.* July 2008.
[44] Maryland Department of Natural Resources. *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change.* http://www.dnr.maryland.gov/climatechange/pdfs/climatechange_phase2_adaptation_strategy.pdf Accessed August 6, 2015.
[45] Professor Sudhakar Yedla. *Climate Change Mitigation Initiatives in Urban Transportation – Strategies to Promote Non-Motorized Modes in Indian Cities.* May 2008.
[46] Maryland Department of Natural Resources. *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change.* http://www.dnr.maryland.gov/climatechange/pdfs/climatechange_phase2_adaptation_strategy.pdf Accessed August 6, 2015.
[47] Maryland Department of the Environment. http://www.mde.state.md.us/Water/Drought/responding/index.asp Accessed 2004.
[48] *National Inventory of Dams.* United States Army http://crunch.tec.army.mil/nidpublic/webpages/nid.cfm
[49] Maryland Department of Natural Resources. http://www.dnr.state.md.us/forests/download/5yearFCAreview.pdf Accessed January 7, 2009.