GEORGE WASHINGTON
REGIONAL COMMISSION

Regional Hazard Mitigation Plan

2017 Update

September 25, 2017

BERKLEY GROUP

EXECUTIVE SUMMARY

The George Washington Region – made up of the City of Fredericksburg and the Counties of Caroline, King George, Spotsylvania, and Stafford – is a growing and prospering region whose environment is closely tied to its success as a place to live, work, and visit. This plan is intended to help citizens and governments in the region understand the risk of natural hazards facing their area, and how to mitigate these risks in the future.

What is Hazard Mitigation?

Hazard Mitigation is the sum of the many actions that can be taken at the local and regional level to reduce or eliminate the risk to human life and property from a variety of natural hazards, including drought, hurricanes, winter storms, and wildfires. Mitigation happens before disaster strikes, saving communities time, effort, and money as opposed to reacting only after an emergency.

The Purpose of This Plan

This plan serves two roles within the region. First, the plan identifies natural hazards that pose a threat to the safety, health, and economy of the region and its member jurisdictions, as well as steps that can be taken to reduce the impact of these natural hazards in the future, helping communities get back on their feet and back to normal lives as quickly and easily as possible. The community can reduce both the impact and cost of natural disasters through advance preparation rather than acting only after disaster has struck.

Second, this plan ensures the region's compliance with the Disaster Mitigation Act of 2000, which requires that local governments develop natural hazard mitigation plans in order to qualify for both pre-disaster and post-disaster grant opportunities. The Act requires that these plans demonstrate "a jurisdiction's commitment to reduce risk from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards." These plans must be updated every 5 years.

Where This Plan Applies

Because storms, droughts, and other natural hazards do not respect jurisdiction boundaries, this plan is conceived to cover the entire region represented by the George Washington Regional Commission (GWRC), with hazard mitigating strategies and actions for local governments as well as for regional authorities and citizens. This 2017 Hazard Mitigation Plan Update applies to the following communities, all of whom have participated in the plan's creation:

- City of Fredericksburg
- Caroline County
- King George County
- Spotsylvania County
- Stafford County
- Town of Bowling Green
- Town of Port Royal

Hazards That Affect Us

The GWRC region faces a variety of natural threats. Some are broad hazards, like drought or winter storms, that are likely to affect the entire region at once. Others, like flooding or wildfires, are usually isolated events that are highly dependent on local topography and conditions. The risks posed by these hazards also vary widely, from the temporary traffic hazards of winter snows, to the rare but devastating effects of tornados and earthquakes. In Section 4, this plan considers the following natural hazards within the GWRC region:

- Dam Failure
- Drought & Extreme Heat
- Wildfires
- Earthquakes
- Sinkholes & Landslides
- Flooding
- Hurricanes & Thunderstorms
- Tornadoes
- Winter Storms & Nor'easters

Measuring Hazards

For each hazard, this plan considers the extent and magnitude of the hazard, past occurrences, and the likelihood of future occurrences. Using data from a variety of local, state, and federal agencies, Section 5 of this plan quantifies the human and economic risks associated with these natural hazards, including dollar values of property damage that may occur under hazard scenarios, lost economic productivity from closed businesses, and displaced population. In some cases these measurements are provided by HAZUS, an analysis and prediction tool provided by the Federal Emergency Management Agency, and based on a combination of US Census and local data.

Mitigation Strategies

The heart of this plan is found in Section 7, where specific mitigation strategies have been proposed for each local government in the region, and for the GWRC itself. These actions will be implemented to better prepare each community for natural disaster events. These actions can be broadly grouped into 6 categories:

Prevention of Future Risk

Government programs and regulations that influence the way land is developed can help prevent future hazards by shaping the way areas of risk grow. Examples include zoning laws, stormwater regulations, and open space programs.

Protection of the Built Environment

Protection measures such as the modification of existing buildings with storm shutters, wind-proofing, raised foundations, flood venting, or the adaptation of impervious and pervious surfaces can help the built environment better withstand natural hazards.

Natural Resource Protection

Natural areas such floodplains, wetlands, and steep slopes provide natural protective functions that can be restored or enhanced through activities such as riparian buffering, erosion and sediment control, slope stabilization, reforestation, and wetland restoration.

Hazard Modification Through Construction

Structural mitigation projects can lessen the impact of some hazards by modifying areas through the construction of reservoirs, levees, diversion channels, storm sewers, or other large-scale municipal engineering solutions.

Emergency Services

Emergency services, including the efforts of fire, rescue, and police personnel, can minimize the impact of a hazard event on people and property during and immediately after such events.

Public Education and Awareness

When natural hazards cannot be avoided, education can make citizens aware of the dangers, what they can do to protect themselves and their properties, and what to do in case of emergency.

What can government do?

Many of the strategies contained in this plan rely on the procedural, regulatory, and emergency response capabilities of local governments. These local capabilities outlined in Section 6, help to plan for the community's growth, function, and health ahead of natural disasters. Also key to local resiliency are critical local facilities (included in Section 5) that provide for government function, organize emergency services and responses, and even local schools that can serve as shelters in emergency situations. Local governments will use the strategies found in this plan to continue to develop local capabilities and critical facilities, planning well in advance for successful responses to natural hazards.

What can citizens do?

Not all hazard mitigation actions fall to governments and agencies. There is a great deal the public can do to participate in community hazard planning and to prepare their own properties and families for natural disasters. Actions the public can take include learning about hazards and their relative risks, obtaining emergency supplies, and creating their own plans to follow in the case of hazard events. A critical part of the follow-up to this plan should be the public education and citizen preparedness items specified in the community action plans. As a regional organizer, the George Washington Regional Commission, can help citizens of all local jurisdictions to better understand the resources available to them, the risks posed by natural hazards, and how best to respond to hazard events.

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ACKNOWLEDGEMENTS

The George Washington Regional Commission (GWRC) would like to acknowledge the local, regional, and state representatives who participated in this plan update. Participants included staff of the GWRC, local emergency services and emergency management staff, representatives of the Virginia Department of Emergency Management, and local planning officials. These staff provided day-to-day plan development guidance and draft review. The Berkley Group, on behalf of the GWRC, provided project management, mapping, and production support. The GWRC would like to thank the following participants for their time, attention, and dedication to their communities:

Participating Communities

This 2017 Hazard Mitigation Plan Update applies to the following communities, all of whom have participated in the plan's creation:

- City of Fredericksburg
- Caroline County
- King George County
- Spotsylvania County
- Stafford County
- Town of Bowling Green
- Town of Port Royal

2017 Plan Update Participants

Name	Jurisdiction	Title/Position
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Stephen Manster	Town of Bowling Green	Town Manager
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Victor Podbielski	City of Fredericksburg	Deputy Emergency Manager
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Tim Ware	George Washington Regional Commission	Executive Director

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1:
Introduction

1 - INTRODUCTION

Hazard Mitigation is the sum of the many actions that can be taken at the local and regional level, setting goals, developing strategies, and outlining tasks and schedules to reduce or eliminate long-term risk to human life and property from a variety of natural hazards. In preparing this plan, the GWRC and its member localities have identified natural hazards that threaten its member jurisdictions; determined the likely impacts of those hazards; assessed the vulnerability of its communities to the studied hazards, as well as the region's current capability to address those hazards; set mitigation goals; and determined and prioritized appropriate strategies that can lessen the potential impacts of hazard events.

The Disaster Mitigation Act (DMA) of 2000 establishes the legal basis for this plan, and for the Federal government's overall nationwide efforts to reduce the cost of disasters in the United States. This act establishes the Pre-Disaster Mitigation Program (PDM), as well as new requirements for the post-disaster Hazard Mitigation Grant Program (HMGP), both serving to give greater responsibility for hazard mitigation planning to local governments. DMA 2000 requires local governments to develop natural hazard mitigation plans in order to qualify for both pre-disaster PDM grants and post-disaster HMGP grants. Specifically, the Act requires that the plan demonstrate "a jurisdiction's commitment to reduce risk from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards." The final plan must be adopted by the jurisdiction and approved by the Federal Emergency Management Agency (FEMA) in order for communities to remain eligible for HMGP funding and to become eligible for PDM funding for future mitigation planning and project implementation.

In order to ensure full federal compliance for its member jurisdictions, the George Washington Regional Commission, working with its local government members, as well as with other state and regional agencies, has developed this Mitigation Plan Update pursuant to the requirements of DMA 2000.

Each of the chapters contained herein has been updated for 2017 to reflect currently available information and up to date local mitigation strategies. Changes include updates to the hazards that have occurred, review and revision of current capabilities, review and update of the previous plan's mitigation strategies, as well as reconsideration of the overall region's mitigation goals and strategies.

1.1 - How to Use This Document

The GWRC Hazard Mitigation Plan has been developed to serve an entire multi-jurisdictional region rather than individual localities. Each jurisdiction-specific section has been designed to allow for each jurisdiction's review and acceptance, independent of the material in the remainder of the plan that applies to the entire region.

Section 4 of this plan identifies each of the natural hazards that the region faces and provides some background and descriptive history of the hazards across the GWRC region, and provides jurisdiction-specific profiles of the hazards that are considered most critical. The Region's vulnerability to those hazards based on historical occurrence and other evidence of risk is assessed in Section 5, as well as an assessment of specific hazards and vulnerabilities for individual jurisdictions within the region. Jurisdiction-specific capability assessments, designed to demonstrate the mitigation tools and capabilities that each jurisdiction may employ, is presented in Section 6. Section 7 of the plan outlines broad, region-wide mitigation goals, objectives, and strategies, while also providing jurisdiction-specific mitigation goals, objectives, and strategies. Finally, Section 8 provides plan implementation and maintenance information that applies across the region as each community updates its material in this plan and implements mitigation projects that follow the priorities and objectives set forth in this planning effort.

Of note, each jurisdiction's elected leadership will be asked to adopt the portions of the plan that apply region-wide and those portions that apply specifically to each respective jurisdiction. Each jurisdiction will then be responsible for updating and maintaining the plan document. The DMA regulations require that the jurisdictions formally review their plans at least once every five years, coinciding with specifications in the Code of Virginia that call for local Comprehensive Plan review at least every five years. Many communities across the country that have developed hazard mitigation plans have found that more frequent updates are often warranted based on the occurrence of natural disasters and subsequent shifts in hazard mitigation priorities. For more information on plan monitoring and updating procedures, please refer to Section 8.

1.2 - Participating Communities

This 2017 Hazard Mitigation Plan Update applies to the following communities, all of whom have participated in the plan's creation:

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2:
The GWRC Region

2 - REGIONAL PROFILE

2.1 - Location and Geography

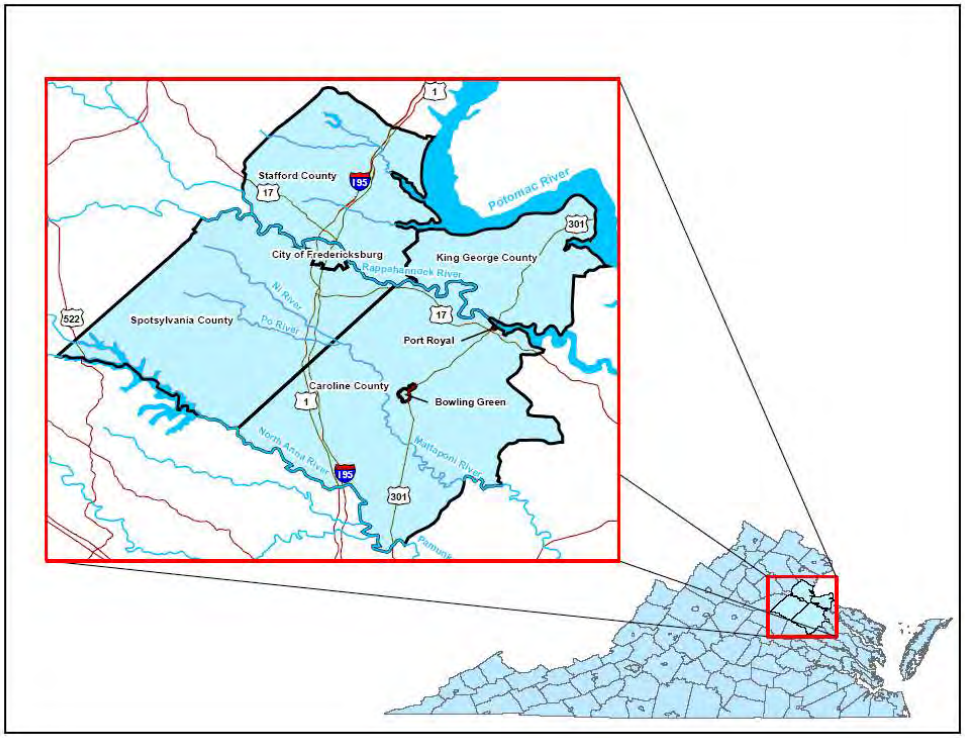
The George Washington Regional Commission region is located in northeastern Virginia, and includes the four counties of Caroline, King George Spotsylvania, and Stafford, the City of Fredericksburg, and two incorporated towns, Port Royal and Bowling Green, both located within Caroline County. The region encompasses 1,410 square miles, covering both hilly piedmont areas of the state, as well as low coastal plains.

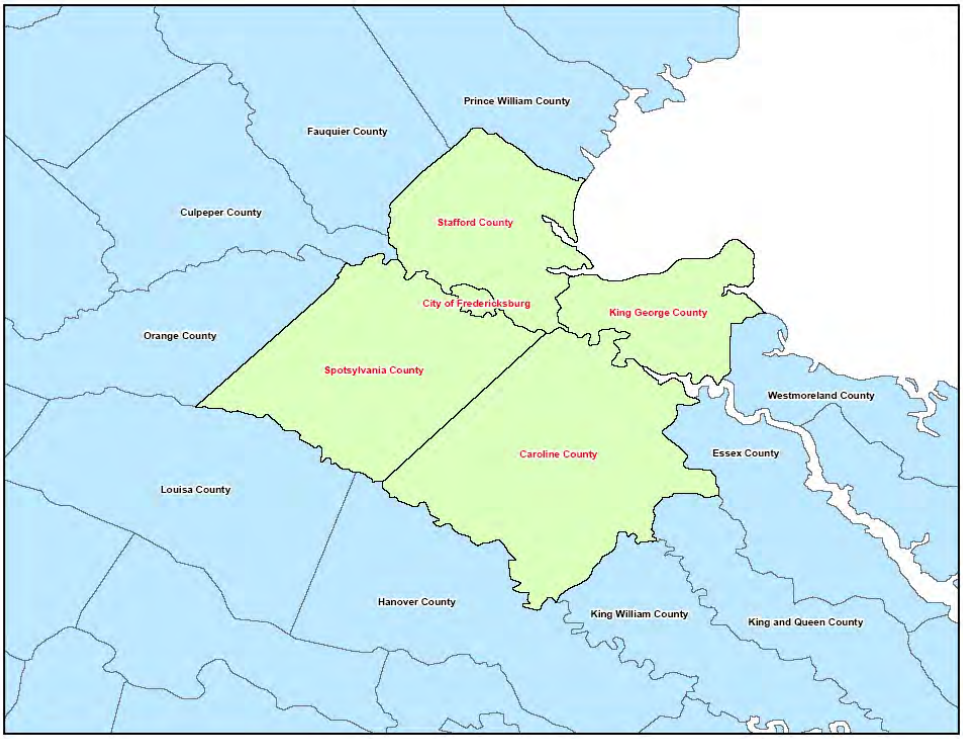
The GWRC region is among the fastest growing areas in Virginia, largely due to its proximity and multiple transportation infrastructure connections to the Washington, D.C area. The City of Fredericksburg, along with Stafford and Spotsylvania Counties, are part of the Washington D.C. Primary Metropolitan Statistical Area (PMSA). Caroline County, including the towns of Bowling Green and Port Royal, is part of the Richmond, VA Metropolitan Statistical Area, and are also seeing strong economic and population growth, along with economic revitalization.

The fall line of the Rappahannock River divides the GWRC region into two distinct physiographic regions, the Northern Piedmont and the Coastal Plains. The Piedmont is a rolling to hilly landscape comprising the western portions of Spotsylvania and Stafford counties. The level Coastal Plain covers sections of eastern Spotsylvania and Stafford counties, the majority of Caroline County and the towns of Bowling Green and Port Royal, and the entirety of King George County.

Interstate 95 is the major transportation feature of the region, shaping many facets of population growth, economic activity, and tourism. As the primary highway route serving the east coast of the United States, I-95 carries between 80,000 and 150,000 vehicles per day at points within the GWRC region.

The GWRC region contains portions of three major Virginia watersheds; the Potomac, the Rappahannock, and the York. The upper reaches of each watershed are typical Piedmont uplands with streams and rivers flowing across the fall line on their way to the Chesapeake Bay. Tidal marshes and flats are common throughout the lower portions of the major Chesapeake Bay tributaries.


Stafford County
Potomac River
City of Fredericksburg
King George County
Rappahannock River
Spotsylvania County
Port Royal
Caroline County
Bowling Green
North Anna River
Mattaponi River
Pamunkey
1
17
95
301
522


Prince William County
Fauquier County
Culpeper County
Stafford County
City of Fredericksburg
King George County
Orange County
Spotsylvania County
Westmoreland County
Caroline County
Essex County
Louisa County
Hanover County
King William County
King and Queen County

2.2 - Population

The total population of the GWRC region has consistently outpaced the overall growth rates of the state or nation. Between the 2000 and 2010 Census counts, the region grew by almost 36 percent. While recent population estimates reveal growth that is slightly slowed from previous figures, this region continues to grow reliably.

Regional Population Growth

Jurisdiction	2000 Census	2010 Census	2000–2010 % Change	2016 (est.)	2010–2016 % Change
Caroline County	22,121	28,545	29.04%	29,704	4.06%
City of Fredericksburg	19,279	24,286	25.97%	27,025	11.28%
King George County	16,803	23,584	40.36%	24,724	4.83%
Spotsylvania County	90,395	122,397	35.40%	129,668	5.94%
Stafford County	92,446	128,961	39.50%	141,915	10.04%
PD 16 Regional Total	**241,044**	**327,773**	**35.98%**	**353,036**	**7.71%**

Source: United States Census (2000 and 2010), Weldon Cooper Center estimates (2016)

The GWRC region's dynamic growth is due, in large part, to its strategic location bridging the growing and prosperous Washington D.C. and Richmond, VA metropolitan areas, and with multi-modal transportation access to these metropolitan areas and large sections of the U.S. eastern seaboard. This has proven to be a profitable location for a wide range of national and international companies. Sustained regional economic growth is very likely in this region, which, along with the Region's competitive location between the Washington and Richmond MSAs, is likely to bring continued population growth.

Regional Employment Data

Industry	2016 Jobs
Agriculture, Forestry, Fishing and Hunting	292
Mining, Quarrying, and Oil and Gas Extraction	111
Utilities	345
Construction	5,929
Manufacturing	2,734
Wholesale Trade	2,971
Retail Trade	16,608
Transportation and Warehousing	3,479
Information	914
Finance and Insurance	6,880
Real Estate and Rental and Leasing	1,459
Professional, Scientific, and Technical Services	8,107
Management of Companies and	1,420

Enterprises	
Administrative, Support and Waste Management & Remediation Services	4,159
Educational Services	1,407
Health Care and Social Assistance	14,575
Arts, Entertainment, and Recreation	1,727
Accommodation and Food Services	13,457
Other Services (except Public Administration)	4,395
Government (fed, state, & local)	28,296
Unclassified	347
Total	**119,580**

Source: Virginia Employment Commission.

2.3 - History of the GWRC Region

Caroline County

Caroline County was created in 1727 through the division of portions of King William, King and Queen, and Essex Counties. Like each of the GWRC jurisdictions, Caroline County holds an important place in both Virginian and American history.

Caroline County covers roughly 549 square miles and remains primarily rural. This county has two incorporated towns: Bowling Green, the county seat; and the historic Town of Port Royal. The county also hosts the United States Army's Fort A.P. Hill, which operates under its own jurisdiction. The Fort is a 76,000-acre installation that provides year-round administrative and logistical support and training for the U.S. Army's Active Army, reserves, and other branches of the military and the U.S. Government. Caroline County is located within 30 miles of the City of Richmond, Virginia.

Town of Bowling Green

The Town of Bowling Green has been the county seat of Caroline County since 1803. It is located 72 miles south of Washington, D.C., 108 miles southeast of Baltimore, Maryland and 35 miles north of Virginia's capital, the City of Richmond. The Town's history includes three centuries of colonial and modern Virginia development. Bowling Green has a well-documented historic district highlighted by the Bowling Green Farm, a brick dwelling that dates to the 17th Century.

Town of Port Royal

The Town of Port Royal was once the only chartered town in Caroline County, and is that county's oldest incorporated town. The town was an important colonial shipping port, and later a center of warehousing, freight, and passenger travel on the Rappahannock River. The town is listed in its entirety on the National Register of Historic Places.

City of Fredericksburg

Fredericksburg is an independent city situated along the Rappahannock River and bordered by Spotsylvania and Stafford counties. This city was founded in 1728, incorporated as a town in 1781, and became an independent city in 1879. The city's historic district covers about 40 square blocks, but the City of Fredericksburg now encompasses a total of 10 square miles. The historic district has over 350 original buildings built before 1870.

The City of Fredericksburg is located just one hour south of Washington D.C. and 45 minutes north of the City of Richmond. Growth and development have occurred in the urbanizing areas surrounding the City. Fredericksburg is closely linked to Stafford and Spotsylvania counties. The Fredericksburg, Spotsylvania, and Stafford area is one of the fastest-growing areas in the Commonwealth.

King George County

King George County was formed in 1720, and like other jurisdictions in the region, King George County's roots are deeply imbedded in both the founding of the United States and in its rural past. The county covers approximately 183 square miles. Both the Potomac and the Rappahannock Rivers border the county, which is located near both the Washington and Fredericksburg urban areas, and is a gateway to Virginia's scenic Northern Neck. Agriculture continues to be a major economic force in King George County, but also hosts a variety of other industries, including the Naval Surface Warfare Center at Dahlgren, the region's largest employer.

Spotsylvania County

Spotsylvania County was formed in 1721 and has played host to many important events in the Commonwealth's history, being the birthplace of several colonial settlements and industries such as iron works and cannon forging, as well as major Civil War battles such as Wilderness and Chancellorsville. The county covers 413 square miles, and has seen increased growth as a suburban extension of both Fredericksburg and the Washington DC metro area. Like other GWRC communities, it contains portions of Interstate 95 and US Route 1, making the county an important part of the east coast transportation system. Despite its advancing suburbanization, southern and western areas of Spotsylvania continue a rural traditional of farms and open spaces.

Stafford County

Stafford County is the northernmost and most densely populated of the counties within the GWRC area. Located only 40 miles from Washington DC, it has been a major location of DC-area suburbanization since the completion of Interstate 95 in the 1960s, and the more recent completion of convenient commuter rail connections. In addition to strong connections to the DC-area, Stafford is also adjacent to the City of Fredericksburg, with associated suburbanization in the County's south due to this relationship.

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3:
The Planning Process

3 - THE PLANNING PROCESS

For the 2017 update, the GWRC retained the consulting services of The Berkley Group to facilitate the update process and produce the Hazard Mitigation Plan document. The Berkley Group assisted with the following tasks:

- Establishing local contacts and participants
- Coordination of state and federal authorities
- Facilitation of the planning meetings
- Identification of the data requirements
- HAZUS and non-HAZUS hazard analysis
- Facilitation of a public input process
- Production of draft and final plan documents
- Submission for acceptance by state and federal authorities.

Each local government seeking the required FEMA approval of its mitigation plan must:

- Participate in the process;
- Detail areas within the Planning Area where the risk differs from that facing the entire area;
- Identify specific projects eligible for funding; and
- Ensure that the governing bodies adopt the plan.

Each of the localities in the GWRC region was an active participant in this plan update process, dedicating staff, time, and resources to creating a plan that not only meets statutory requirements, but that can be a reference and resource for future local planning efforts. The Berkley Group and GWRC would like to thank these local governments and their individual staff participants for their attention and effort.

Step 1: Organization

The 2017 Hazard Mitigation Plan Update was steered by a committee of GWRC, consultant, and local government representatives, including both planning and emergency management staff. The Committee met during the planning process to discuss major plan elements including basic structure, development trends, local capabilities, and mitigation strategies. An example of the emailed meeting invitations in included in the appendix of this document. Meetings and topics included:

- *July 12, 2016 – Kickoff Meeting*
- *November 30, 2016 – Resiliency and Resources Overview*
- *January 9, 2017 – Regional and Local Strategies*

The planning process also made use of regular meetings of the regional emergency managers group, whose members overlap with many of the local hazard mitigation representatives. Regular updates and data requests were provided to this group. Typical attendees of each meeting included representatives from local first response agencies, planning departments, public works, local emergency management personnel, and other community leaders. A list of team participants is included in the Acknowledgements

section at the front of this plan document. Attendance and agendas for each committee meeting or event are on file at the GWRC office in Fredericksburg. While the committee was assembled to assist with the development of this plan, the committee structure may also facilitate updates of the plan over time as needed by the member communities and/or as required by statute.

Step 2: Public Involvement

An important part of this planning process is providing citizens with an opportunity to learn about hazard mitigation planning and to provide input on the draft mitigation plan. This process can also increase citizen awareness of potential natural hazards present in the region and serve as an early step in the education and outreach programs that are proposed in the mitigation strategies contained within the plan.

Once a draft Hazard Mitigation Plan was produced, public involvement efforts took place during the months of March and April 2017. The plan was presented publicly at the offices of the George Washington Regional Commission on April 17, 2017, with local and regional staff members, local elected leaders, and representatives of other regional organizations in attendance.

The public was also encouraged to review and comment on the draft plan by participating local governments using forums and methods familiar to their citizens. The plan was announced through the following means, with opportunities for public comment and involvement:

- Local government websites
- Applicable citizens' committees
- Social media, including Facebook
- Local access television broadcasts

Examples of these public outreach efforts are included in the appendix of this document. Although no public comments were received, the participating localities hope that these efforts have helped to raise public awareness of natural hazards and hazard mitigation issues.

Step 3: Coordinate with other Entities, Agencies, and Plans

A variety of local, regional, state, and federal agencies were consulted in the process of creating this plan update. Outside agencies contributed to the data needs of the plan, received plan updates, and performed important guidance and analysis functions during the plan's development. The following agencies and entities were involved, or were contacted, during the plan update process:

- Federal Emergency Management Agency
- Virginia Department of Emergency Management
- Virginia Department of Forestry
- Virginia Department of Conservation and Recreation
- University of Mary Washington
- Mary Washington Hospital
- Germanna Community College
- Spotsylvania Regional Hospital

In addition to the agencies listed above, the creation of this plan involved data and other planning resources provided by the following agencies:

- National Climatic Data Center (NCDC)
- Virginia Department of Emergency Management (VDEM)
- Virginia Department of Conservation and Recreation (DCR)
- Centers for Disease Control and Prevention (CDC)
- Virginia Department of Health (VDH)
- National Oceanic and Atmospheric Association (NOAA)
- Federal Emergency Management Agency (FEMA)
- National Weather Service (NWS)
- U.S. Geological Survey (USGS)
- U.S. Census Bureau
- U.S. Department of Agriculture (USDA)

Both the Federal Emergency Management Agency (FEMA) and Virginia Department of Emergency Management (VDEM) provided guidance and document review for this plan. VDEM also provided hazard impact data for tornadoes, winter storms, and drought that can be found in Section 5. The Virginia Department of Forestry provided the information on past wildfires found in Section 4, as well as the fire risk data found in Section 5. The Virginia Department of Conservation and Recreation provided data on the number of dams in the region, as well as information on risks of dam failure to downstream properties. Regional organizations including the University of Mary Washington, Mary Washington Hospital, Germanna Community College, and Spotsylvania Regional Hospital are important stakeholders given their roles in community education and emergency response, and contributed to the formation of the hazard mitigation strategies found in Section 7.

Data on past tornado, heat, winter storm, and hurricane events (found in Section 4), as well as risk data for these hazards (Section 5), was contributed by the National Climatic Data Center (NCDC), National Oceanic and Atmospheric Association (NOAA), and National Weather Service (NWS). The U.S. Geological Survey (USGS) provided data on earthquake hazards. U.S. Department of Agriculture (USDA) data was used to assesses the drought vulnerability of GWRC localities found in Section 5. Information from the U.S. Census Bureau, Centers for Disease Control and Prevention (CDC), and Virginia Department of Health (VDH) was used in the assessment of heat vulnerability found in Section 5.

Coordination with other community planning efforts is paramount to the success of a hazard mitigation plan. This plan incorporates elements of local visionary and regulatory planning documents including comprehensive plans, zoning ordinances, subdivision ordinances, and emergency operations plans. These local regulatory documents should in turn reference or incorporate elements of this Hazard Mitigation Plan, creating a fully integrated effort to reduce hazard impacts and maintain resiliency as a core local and regional planning element. The development of this Plan utilized information included in the following community plans, studies, reports, and initiatives:

- Municipal Comprehensive Plans from GWRC region localities
- Codified Ordinances (Zoning and Subdivision) from GWRC region localities
- Virginia Uniform Statewide Building Code
- Commonwealth of Virginia Hazard Mitigation Plan
- Emergency Operations Plans from GWRC region localities
- Flood Insurance Studies and Flood Insurance Rate Maps
- GWRC region Tax Assessor and Land Use data

Step 4: Assess the Hazard

For the 2017 update, the committee relied on previous editions of the GWRC Region's Hazard Mitigation Plan to determine what natural hazards threaten the region. Assessments of past natural occurrences confirmed this list, and likelihood of recurrence was considered. The hazards identified and investigated in this plan include:

Hazards Included in This Plan

Hazard	Plan Section
Dam Failure	4.1.1
Drought & Extreme Heat	4.1.2
Wildfires	4.1.3
Earthquakes	4.1.4
Sinkholes & Landslides	4.1.5
Flooding	4.1.6
Hurricanes & Thunderstorms	4.1.7
Tornadoes	4.1.8
Winter Storms & Nor'easters	4.1.9

Step 5: Assess the Problem

With regional hazards identified, vulnerability assessments were completed to gauge the potential impact of identified hazards on the GWRC region and its member jurisdictions. The committee also conducted capability assessments to determine the current ability of each jurisdiction to mitigate the hazards through existing policies, regulations, programs, and procedures. The analyses identified areas where improvements could or should be made.

Step 6: Set Planning Goals

This plan, and the associated strategies found in this section, are based on four broad goals established in the state-wide hazard mitigation plan:

- **Goal 1:** Identify and implement projects that will eliminate long-term risk, directly reduce impacts from hazards, and maintain continuity of critical societal functions.
- **Goal 2:** Incorporate mitigation concepts and objectives into existing and future policies, plans, regulations, and laws in the Commonwealth.
- **Goal 3:** Improve the quality of the data and analysis used in the hazard identification and risk assessment process in state, local, and university hazard mitigation plans.
- **Goal 4:** Through training, education, and outreach promote awareness of hazards, their risk, and potential mitigation actions in order to increase resiliency.

Step 7: Mitigation Activities

Organized along identified local and regional goals, mitigation activities were drafted by each locality. Draft mitigation activities and strategies were shared with all localities at a group forum and revised before incorporation into the plan. Mitigation strategies and activities were organized by the following strategy types:

- Prevention of Future Risk
- Protection of the Built Environment
- Natural Resource Protection
- Hazard Modification through Construction
- Emergency Services
- Public Education and Awareness

As an update to previously adopted Hazard Mitigation Plans for the GWRC region, the creation of mitigation strategies began with the analysis of strategies expressed in the 2012 and 2006 plans, identifying items that had already been accomplished, and which remaining items were still seen as viable community priorities.

Step 8: Draft an Action Plan

The prioritized mitigation measures were further developed into an action plan that identifies the following for each measure:

- Responsible office;
- Priority (high, medium, or low);
- Potential funding sources; and
- Schedule for completion.

Step 9: Adopt the Plan

Each jurisdiction within the GWRC region shall adopt the plan through its respective governing body.

Step 10: Implement the Plan, Evaluate and Revise as Needed

Implementation is critical to the overall success of hazard mitigation planning. Upon adoption, the Hazard Mitigation Plan faces the crucial transition from planning to implementation. While many worthwhile strategies have been identified throughout this process, local authorities must educate public and community leaders as to the importance of these measures, as well as balance these objectives within the limited resources of time, staff, and funding.

In addition, the Hazard Mitigation Plan must be maintained over the long term, including ongoing efforts to monitor and evaluate the implementation of the plan, and to update the plan as progress, roadblocks, or changing circumstances occur.

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4:
Hazard Identification & Risk Assessment

4 - HAZARD IDENTIFICATION AND RISK ASSESSMENT

The hazard identification and risk assessment provides information to allow GWRC region communities to better understand hazards and their impacts. This information provides the framework for a community to develop mitigation strategies and to implement plans to help reduce the impact of future hazards.

The 2017 Update includes a complete update of all hazard history and data, providing the most up to date information on the occurrences of previous hazard events. The hazard profiles include location, extent, and previous occurrences as required by federal guidelines.

The hazard identification and risk assessment covers Planning Steps 4: Assess the Hazard and Step 5: Assess the Problem. The hazard identification and risk assessment for the GWRC region was prepared in the following format:

Regional Hazard Identification

For the 2017 update, this plan addresses all hazards included in previous versions of the plan. While additional hazards have been considered, including those detailed in the State of Virginia Hazard Mitigation Plan, it has been decided that no new hazards should be included. Furthermore, updates to this chapter include historical occurrence updates, hazard profile updates, and new rankings.

Community Specific Hazard Identification

Section 4.3 presents the community-specific sections where those natural hazards that affect each member jurisdiction differently are discussed.

Regional Vulnerability Assessment

Section 5.1 describes vulnerabilities that are common to all communities within the GWRC region.

Community-Specific Vulnerability Assessment

Section 5.2 presents the vulnerability assessments that were performed for each jurisdiction for critically identified hazards and the results of these analyses.

Regional Capability Assessment

Section 6.1 presents State, Regional, and Federal mitigation capabilities that are common to all communities within the GWRC region.

Community-Specific Capability Assessment

Section 6.2 describes each jurisdiction's capability to deal with the hazards from both a response and a policy capability. A capability assessment matrix was used for this purpose.

4.1 - Regional Hazard Identification

Reviewing hazards included in the 2006 and 2012 plans, as well as identified hazards included in the Commonwealth of Virginia's Hazard Mitigation Plan, regionally applicable hazards were identified for purposes of the 2017 plan update. This selection is based on hazard events over the preceding five year period. The natural hazards identified and investigated in the 2017 Update include the following:

Profiled Hazards

2017 Hazard Types	Section
Dam Failure	4.1.1
Drought & Extreme Heat	4.1.2
Wildfires	4.1.3
Earthquakes	4.1.4
Sinkholes & Landslides	4.1.5
Flooding	4.1.6
Hurricanes & Thunderstorms	4.1.7
Tornadoes	4.1.8
Winter Storms & Nor'easters	4.1.9

Historical data was collected for the above hazard types. By examining the historical occurrences of each hazard, along with the impacts, the committee was able to identify the hazards that pose the most significant risks to the region. This identification will allow the George Washington jurisdictions to focus their hazard mitigation planning efforts on the hazards most likely to have an impact on them in the future, based on the probability that a certain type of natural hazard would affect the region and the potential extent and severity of the damage caused by that hazard.

The probability of occurrence for each hazard was determined using available data, including the history of events.

4.1.1 - Dam Failure

Description

For the purposes of this plan, dam failure is addressed as a natural hazard because flooding conditions are a consequence of weather events. Dam failure can occur if hydrostatic pressure behind the dam exceeds its design capacity or the crest of the dam is overtopped and rushing flood water scours the base of the dam. The Virginia Soil and Water Conservation Board (VS&WCB) established the Virginia Dam Safety Program to provide for safe design, construction, operation and maintenance of dams to protect public safety. Dams that meet specific regulatory criteria are regulated. The owner of each regulated dam is required to apply to the VS&WCB for an operation and maintenance certificate. The application must include an assessment of the dam by a licensed professional engineer, an operation and maintenance plan, and an emergency action plan. The emergency action plan is filed with the appropriate local emergency official and the Department of Emergency Services.

A dam may be exempt from the regulation if any of the following criteria apply:

- The dam is less than six feet in height;
- The dam has a capacity less than 50 acre-feet and is less than 25 feet in height;
- The dam has a capacity of less than 15 acre-feet and is more than 25 feet in height;
- The dam is used primarily for agricultural purposes and has a capacity less than 100 acre-feet (if use or ownership changes, the dam may be subject to regulation);
- The dam is owned or licensed by the Federal Government; or
- The dam is operated for mining purposes under 45.1-222 or 45.1-225.1 of the *Code of Virginia*.

Extent and Magnitude

The U.S. Army Corps of Engineers (USACE) compiles a National Inventory of Dams (NID), ranking each dam on its downstream hazard potential in the event of failure. It is important to note that this is not an assessment of the structural integrity of the dam. The following table shows the number of dams in each community based on their NID ranking of downstream hazard potential. Downstream hazard potential is defined as:

I. **Low** - Dams assigned the low hazard potential classification are those where failure or disoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.
II. **Significant** - Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
III. **High** - Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

National Inventory of Dams in GWRC Region

Community	Downstream Hazard Potential		
	High	Significant	Low
Caroline County	3	35	51
City of Fredericksburg	0	0	0
King George County	1	1	8
Spotsylvania County	5	7	9
Stafford County	7	11	6
GWRC Total	**16**	**54**	**74**

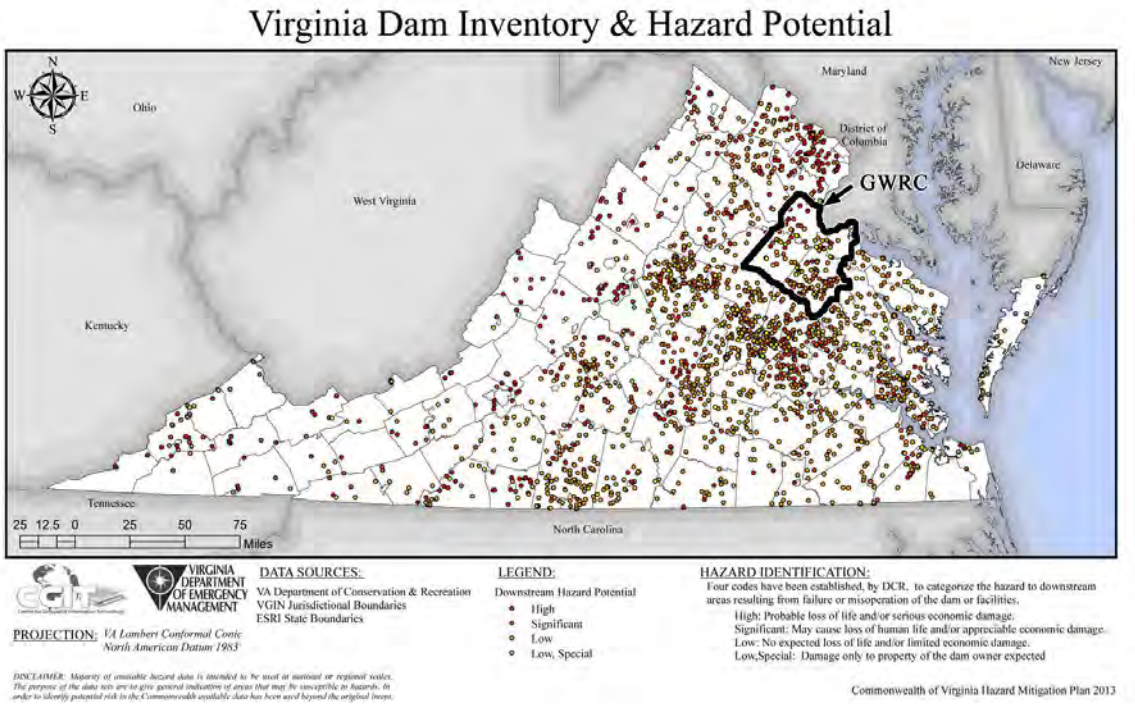
Source: National Inventory of Dams – as reported by Virginia Department of Emergency Management.

Past Occurrences

Although a historical log of dam failures for the Commonwealth of Virginia has not been prepared by the Virginia Soil and Water Conservation Board (VS&WCB), local representatives have occasionally noted dam failures in the GWRC region. In recent history, Grant Lake within the Lake Wilderness subdivision of Spotsylvania County was placed under "alert" condition due to the potential for subsidence/sinkhole. Stafford County officials identified the potential threat of earthen dam failure at Lake Arrowhead in 2008.

Likelihood of Future Occurrences

The Virginia Soil and Water Conservation Board (VS&WCB) issues certificates to the owner of each regulated dam for a period of six years. If a dam has some deficiency but does not pose imminent danger, the board may issue a two-year *conditional certificate* during which time the owner is to correct the deficiency. After a dam is certified by the board, periodic inspections by an engineer are required. This procedure makes dam owners accountable, reducing the likelihood of dam failure, and makes local emergency management officials aware of deficient conditions in advance of potential hazards.



Location and Hazard Potential of Virginia Dams. VDEM.

4.1.2 - Drought and Extreme Heat

Drought

Description

A drought is a period of drier-than-normal conditions that results in water-related problems. In a one-year time frame, droughts are considered large when the 12-month rainfall averages approximately 60 percent of normal. On a multi-year time scale, 75 percent of normal rainfall indicates a serious problem. High summer temperatures can exacerbate the severity of a drought. Most of the soil is relatively wet, and a great deal of the sun's energy goes toward evaporation of the ground moisture. However, when drought conditions eliminate soil moisture, the sun's energy goes toward heating the ground surface and temperatures reach into the low 100's, further drying the soil. This can have a devastating effect on crops, stream levels and water reserves. A short-term precipitation deficit of six summer weeks can often ruin crops.

Extent and Magnitude

One measure of drought is the scale maintained by the U.S. Drought Monitor, mapping occurrences, areas, magnitudes, and durations of drought nationwide. The classifications of the USDM are presented in the following table.

The U.S. Drought monitor indicates that the GWRC region has experienced multiple episodes of drought since 2000, including one episode of Exceptional Drought (D4), the most severe magnitude measured by this scale. During periods of drought, the Commonwealth of Virginia, as well as many local governments, have called for water restrictions or bans on open burning in an effort to reduce the risk of wildfire.

Although the severity and duration of droughts experienced in Virginia is relatively limited compared to many areas of the United States, the GWRC region is susceptible to drought conditions and their impacts on agriculture and community water systems.

United States Drought Monitor

USDM Classifications	
D0	Abnormally Dry
D1	Moderate Drought
D2	Severe Drought
D3	Extreme Drought
D4	Exceptional Drought

Source: United States Drought Monitor, 2017.

Location

All areas of Virginia are susceptible to drought, which is defined by a combination of intensity and duration. High summer temperatures can exacerbate the severity of a drought; normal high summer temperatures in the central and northern Virginia areas can reach the 90 degree Fahrenheit mark and higher. Droughts lasting a year in the Mid-Atlantic occur when the region receives 60 percent of the typical 40 inches of rain, begin to draw down water wells and livestock ponds and decrease stream flows and water reserves.

Past Occurrences

Since 2000 the GWRC region, as measured by the climate station at Fort A.P Hill in Caroline County, has experienced one episode of Exceptional Drought (D4), one episode of Extreme Drought (D3), three episodes of Severe Drought (D2), and numerous periods classified as Moderate Drought (D1) and Abnormally Dry (D0).

The drought of 2002 peaked at D4 (Exceptional Drought), the highest level of the USDM scale, and saw large portions of Virginia in drought conditions for a period of greater than one year, peaking in the late summer of 2002 with record low rainfall totals and low river flows, exceptional crop losses, and several local water systems rendered inoperable, mainly those relying on direct river withdrawals.

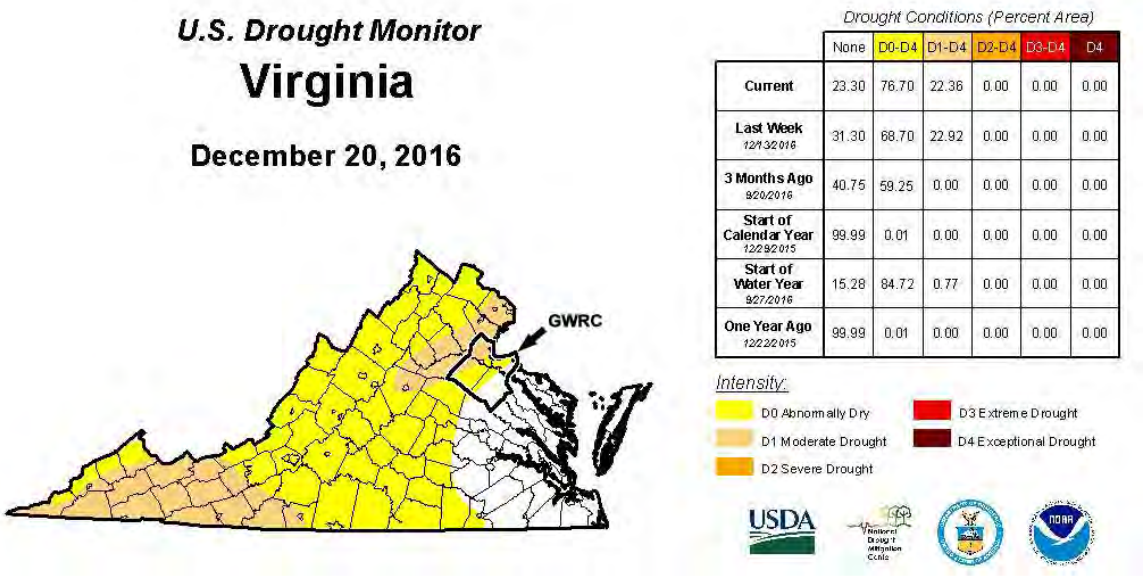
The dry conditions in July of 2007 were also harsh in the GWRC region. This episode peaked at Extreme Drought (D3), with average rainfall totals for the region reaching as high as six inches below normal. As a result, many jurisdictions in the region imposed restrictions on water use. The USDA reported deteriorated soil moisture conditions for the counties of King George, Caroline, and Stafford. There was noticeable crop damage, specifically to corn and soybeans. The USDA estimated that the production of corn for 2007 would be up to 60 percent below the average annual yield.

By August of 2007 conditions began to improve until another dry spell affected the region in September. The average rainfall totals for September were between 8 to 10 inches below normal. The National Drought Monitor listed much of the region under extreme drought conditions through the end of the month. Many localities continued the water use restrictions that were set in July. At this time the summer harvest was in full effect, soybean yield was only between 20 to 40 percent per acre according to a USDA report. By the end of the month the USDA designated several counties throughout the Commonwealth as drought disaster areas. The one year period from April of 2007 to March of 2008 was the 9th driest period in the region's history and the driest since 2002. The average precipitation totals for that year were over 7 inches off the region's 5-year average. Stream flow discharge in the major creeks and rivers of the region were severely low relative to their average that summer. For example, the Rappahannock River near Fredericksburg was running at a competency of only 24 percent of its 10-year average for the months of June through September.

The summer of 2010 presented another harsh period for the GWRC region. The region only reached 68 percent of its average rainfall. The drought conditions were particularly harsh to the region's agriculture. A USDA report at the end of July claimed that 50 percent of the dry land corn crop was lost to severely dry conditions within the region. By the middle of August the 69 percent of the state's corn conditions were rated as either very poor or poor. There was also noticeable "browning out" of the hayfields and pastures. The apparent lack of precipitation had a noticeable effect on the region's water. Streamflow discharge for the region's rivers and streams were noticeably lower than their 10-yr average for the months of June through September 2010 (NOAA, 2011).

Likelihood of Future Occurrences

VDEM rates Virginia's drought risk as "Significant," with Virginia communities experiencing approximately 20 years of severe drought in the last century, which has caused millions of dollars of damage. Proper mitigation planning can lessen a drought's impact and keep communities from being severely impacted by drought conditions.



United States Drought Monitor status; December 20, 2016.

Extreme Heat

Description

The extreme heat hazard, often referred to as the silent killer, results from high daily temperatures combined with high relative humidity. High relative humidity retards evaporation, robbing the body of its ability to cool itself. On average, approximately 175 Americans die as a result of extreme heat exposure every year (NOAA).

Extent and Magnitude

Incidents of excessive heat in the George Washington Region are defined by Heat Watches and Heat Warnings issued by the National Weather Service (NWS). These watches and warnings are issued based on Heat Index temperatures rather than air temperature alone.

When heat gain exceeds the level the body can remove, body temperature begins to rise, and heat related illnesses and disorders may develop. The Heat Index (HI) is the temperature the body feels when heat and humidity are combined. The following table presents the HI that corresponds to the actual air temperature and relative humidity. This chart is based upon shady, light wind conditions. Exposure to direct sunlight can increase the HI by up to 15°F. (NOAA 2004).

Location

While the severity of extreme heat is quite small compared with the rest of the nation, the entire GWRC region is subject to high temperatures, with occasional summer days reaching over 100°F, often accompanied by high humidity.

Temperature (F) versus Relative Humidity (%).

°F	90%	80%	70%	60%	50%	40%
80	85	84	82	81	80	79
85	101	96	92	90	86	84
90	121	113	105	99	94	90
95		133	122	113	105	98
100			142	129	118	109
105				148	133	121
110						135

Source: NOAA.

Past Occurrences

During the summer (June-August) of 1999, the United States experienced an intensive drought and heat wave. The east coast was the area hardest hit by the drought, with record and near-record short-term precipitation deficits occurring on a local and regional scale resulting in agricultural losses and drought

emergencies being declared in several states (NOAA). Recent heat events are summarized in the table below.

Significant Heat Events – GWRC Region

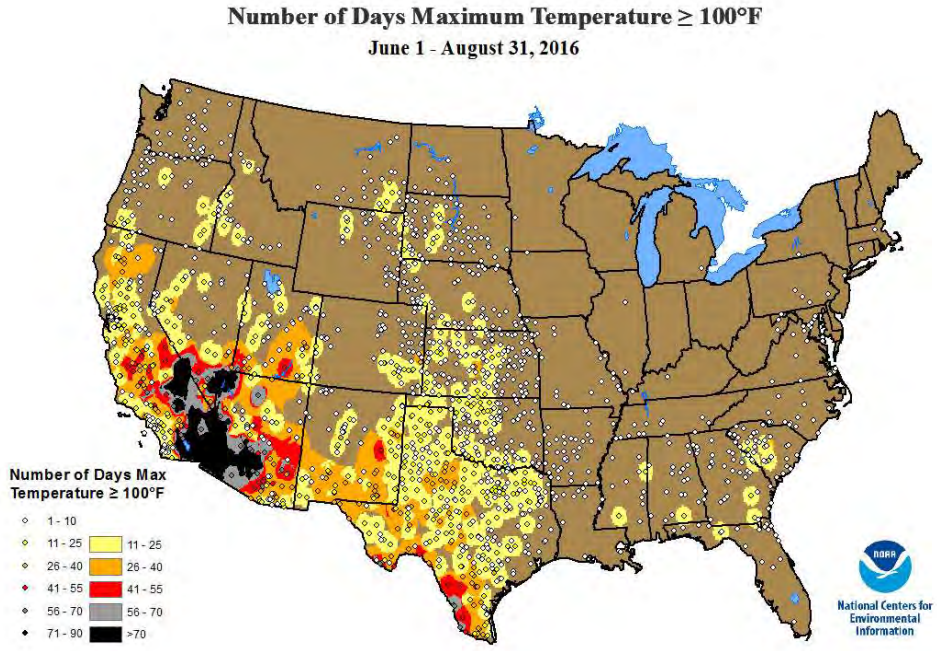
Date	Event	Description
August 16, 2016	Heat	A southerly flow around high pressure over the Atlantic ushered in unseasonably hot and humid conditions. Heat indices around 105 degrees were reported at observations nearby.
August 13, 2016	Heat	A southerly flow around high pressure ushered in unseasonably hot and humid conditions. Heat indices were reported around 105 degrees at observations nearby.
August 12, 2016	Heat	A southerly flow around high pressure to the east cause hot and humid conditions over the area. Heat indices around 105 degrees were reported at observations nearby.
July 25, 2016	Heat	A southwesterly flow around high pressure over the Atlantic pumped in plenty of moisture while hot conditions persisted due to an upper-level ridge of high pressure. The heat and humidity caused dangerous heat indices. Heat indices around 105 degrees were reported at nearby.
July 23, 2016	Heat	A southwesterly flow around high pressure over the Atlantic pumped in plenty of moisture while hot conditions persisted due to an upper-level ridge of high pressure. The heat and humidity caused heat indices to top off around 105 degrees. Heat indices around 105 degrees were reported nearby.
July 19, 2013	Heat	High pressure was located over much of the eastern United States for a consecutive day 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 109 degrees at Quantico.
July 18, 2013	Heat	High pressure was located over much of the eastern United States 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 107 degrees at Quantico.
July 26, 2012	Heat	High pressure off the coast allowed for a hot and humid air mass to remain over the Mid-Atlantic. Heat indices around 105 degrees were estimated based on observations nearby.
July 18, 2012	Heat	High pressure off the coast allowed for a hot and humid air mass to remain over the Mid-Atlantic. Heat indices were estimated to be around 105 degrees.
July 8, 2012	Heat	Upper-level high pressure built overhead while surface high pressure moved off the coast. A southerly flow combined with sunshine and subsidence for hot and humid conditions. Heat indices were estimated to be between 105 and 109 degrees based on observations nearby.
July 5, 2012	Heat	Upper-level high pressure built overhead while surface high pressure moved off the coast. A southerly flow combined with sunshine and subsidence for hot and humid conditions. Heat indices were around 105 degrees at NYG Airport.
July 4, 2012	Heat	Upper-level high pressure built overhead while surface high pressure moved off the coast. A southerly flow combined with sunshine and subsidence for hot and humid conditions.
June 29,2012	Excessive Heat	Plenty of moisture from the Gulf of Mexico caused high humidity during the 29th. Upper-level high pressure along with sunshine caused extremely hot conditions. The combination of the heat and humidity caused heat indices to be near or above 105 degrees.
June 21, 2012	Heat	Strong subsidence associated with upper-level high pressure caused hot conditions on the 21st. A southerly flow around high pressure off the coast ushered in high humidity during this time. The combination of the heat and humidity caused heat indices to reach 105 degrees in some locations.
June 20, 2012	Heat	Strong subsidence associated with upper-level high pressure caused hot

		conditions on the 20th. A southerly flow around high pressure off the coast ushered in high humidity during this time. The combination of the heat and humidity caused heat indices to reach 105 degrees in some locations.
May 28, 2012	Heat	A southerly flow around high pressure over the Atlantic Ocean provided hot and humid conditions. Heat indices were around 100 degrees during the afternoon and early evening hours.

Source: NOAA.

Likelihood of Future Occurrences

The threat of extreme heat to the GWRC communities is episodic and, although it cannot be controlled, threats to population can be minimized by warnings and public awareness of the potential dangers that extreme heat presents.



Days Over 100-Degrees Fahrenheit; Summer 2016. NCEI.

4.1.3 - Wildfires

Description

A wildfire is an uncontrolled fire spreading through vegetative fuels, possibly consuming structures. They often start unnoticed and spread quickly, often causing dense smoke that fills the area for miles around. The magnitude of a wildfire can range from a very localized event that produces little or no damage to a blaze that consumes many thousands of acres and damages buildings and infrastructure. Naturally occurring and non-native species of grasses, bush, and trees can fuel wildfires.

Extent and Magnitude

Generally, there are three major factors to consider in assessing a community threat from wildfires: topography, vegetation, and weather.

The type of land cover in an area affects a number of factors including ease of ignition, the intensity with which a fire burns, and the facilitation of wildfire advancement. Topographic variations, such as steeper slopes, can lead to a greater chance of wildfire ignition. Generally speaking, steeper slopes are predisposed to convective pre-heating, which warms and dries the vegetative cover. Also, slopes that generally face south receive more direct sunlight than those facing north. Direct sunlight in turn dries vegetative fuels, thereby creating conditions that are more conductive to wildfire ignition. Population density has a causal relationship to wildfires because an overwhelming majority of the wildfires in Virginia are ignited intentionally or unintentionally by humans. Travel corridors increase the probability of human presence, which increases the potential for wildfire ignition. Hence, areas closer to roads have a higher ignition probability. Hurricanes, thunderstorms, and other wind events may also bring down trees, leaving an increase in potential fuel for wildfires. The Virginia Department of Forestry (VDOF) has initiated a public awareness campaign to educate the public to this increased fire hazard.

Location

Geographically, wildfire risk as determined by the Virginia Department of Forestry (VDOF) varies across the GWRC region. Approximately 62.7 percent of the GWRC region is located within a high fire risk zone.

Past Occurrences

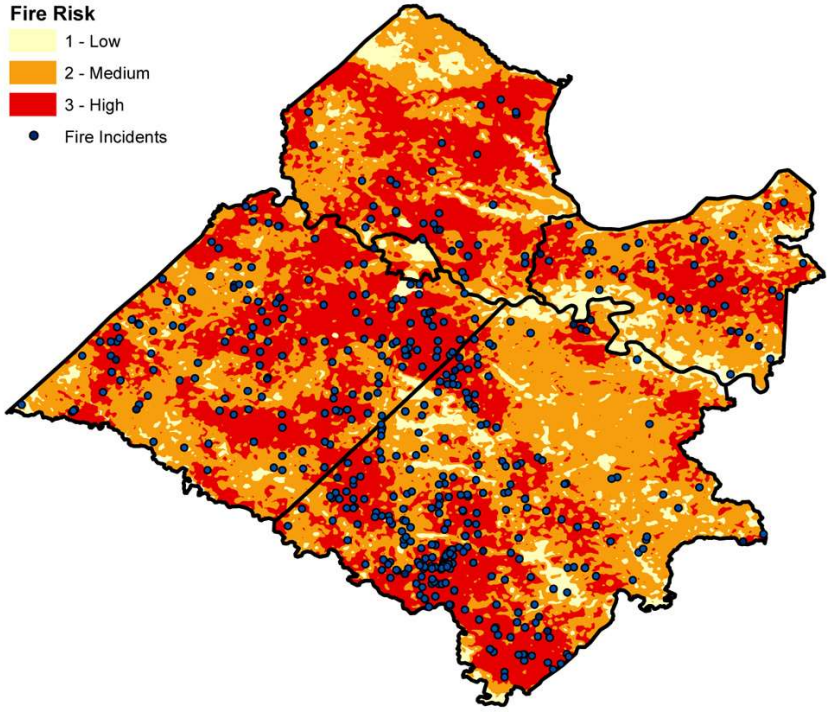
Wildfire incidents vary widely across the GWRC region, affecting urban and rural areas very differently. However, the past wildfire events charted by this plan update have resulted in over 6,100 acres burned and over $5,300,000 in damages. The majority of these fires were caused by humans; over 70 were determined to be caused by either lightning or some unknown cause. (VDOF).

See Section 4.3 for historical wildfire data for each GWRC community.

Likelihood of Future Occurrences

Using the factors described above, VDOF assigned a “fire-risk” rating of low, moderate, or high to various areas throughout the GWRC region. With this system, VDOF has determined that approximately 28.5 percent of the GWRC area is in a high fire risk zone, while 64.4 percent is categorized as medium risk, and 7.1 percent as low risk.

It is apparent that wildfires are a danger within the GWRC area. The area’s specific vegetative cover, topography and urban characteristics (relatively high population and dense road networks in some areas) furnish an environment with a predominantly high fire risk. Historical evidence shows that many historic fires could have been prevented with proper mitigation, lessening the negative impact on the environment and the citizens of the GWRC area.



Wildfire Risk and Past Events; GWRC region. VDOF.

4.1.4 - Earthquakes

Description

An earthquake is defined as a series of elastic waves in the crust of the earth, caused by abrupt easing of strains built up along geologic faults and by volcanic action, and resulting in movements in the earth's surface. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of caverns. Earthquakes can affect hundreds of thousands of square miles; cause damage to property measured in the tens of billions of dollars; result in loss of life and injury to hundreds of thousands of persons; and disrupt the social and economic functioning of the affected area.

Extent and Magnitude

According to the Virginia Department of Mines, Minerals and Energy (DMME), Virginia has a moderate earthquake risk (similar to most states on the eastern seaboard). This risk assessment is further supported by the USGS. The USGS rates areas of the United States for their susceptibility to earthquakes based on a two percent probability of a given peak acceleration (%g) being exceeded in a 50-year period.

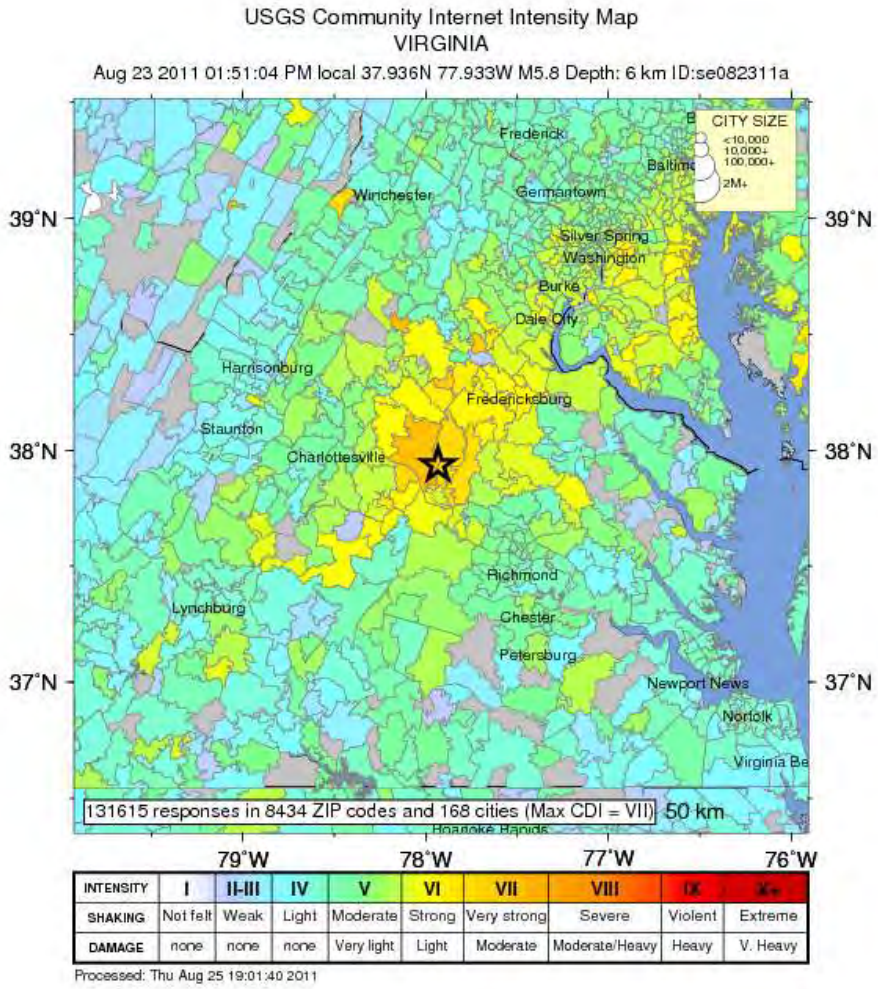
Earthquakes may also be rated using the Mercalli Intensity Scale, which measures the observable effects of an earthquake rather than measurements of its intensity or momentary energy. The Mercalli scale quantifies the effects of an earthquake on people, the landscape, and man-made structures such as roads and buildings on a scale from I – for earthquakes not felt at all – to XII for earthquakes that cause total destruction.

Location

The GWRC region lies in an area of moderate seismic risk, with a peak acceleration of 6 to 10g, which is considered a moderate hazard probability.

Past Occurrences

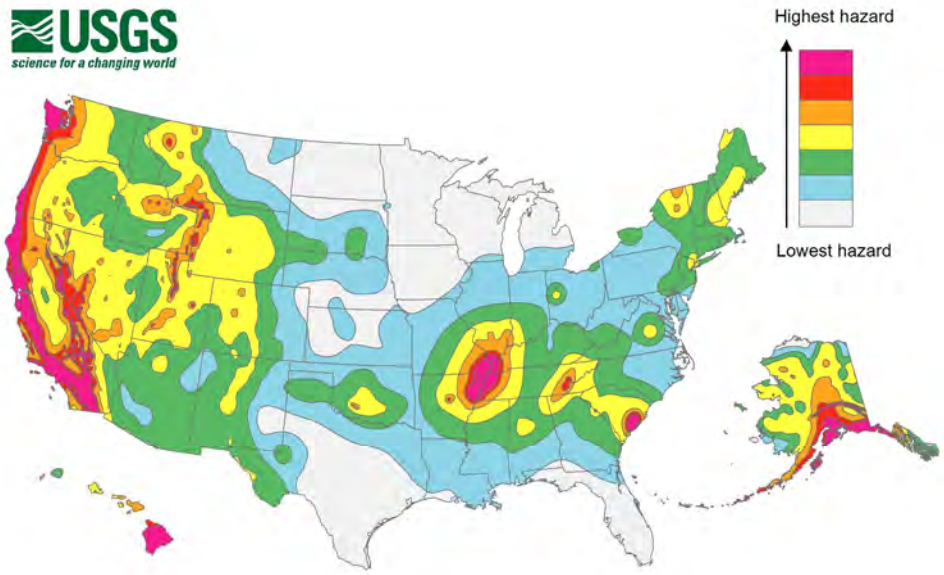
Over 300 earthquakes have been recorded within or near the boundaries of Virginia. Nineteen of these events had a magnitude of four or higher on the Richter scale. Recently a 5.8 magnitude struck near the GWRC region in Mineral, VA. The Mineral earthquake, occurring on August 23, 2011, was reportedly felt as far north as Boston, as far south as Georgia and as far west as Chicago. Effects of the earthquake were reported from over 8,434 zip codes, ranging from weak (II-III Mercalli scale intensity) to very strong (VII Mercalli scale intensity).



Community Intensity Map; August 23, 2011 Earthquake. USGS.

Likelihood of Future Occurrences

Virginia has experienced quakes of a larger magnitude in the past, and will likely experience more at some point in the future. However, compared to the frequency of other hazards such as hurricanes and floods, the frequency with which larger, damaging earthquakes occur in Virginia is considerably lower.



Nationwide Earthquake Hazard Risk. USGS.

4.1.5 - Sinkholes and Landslides

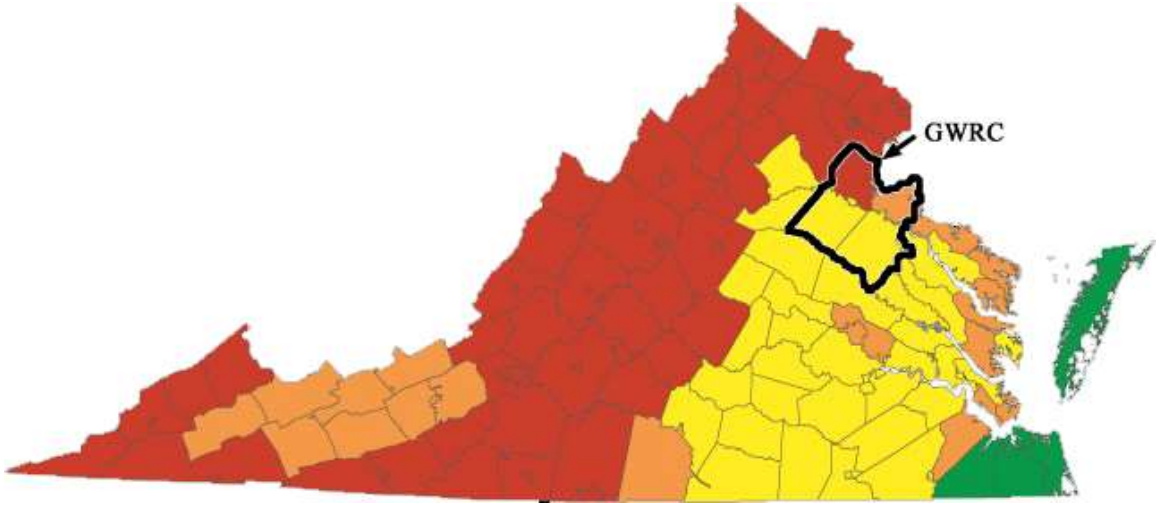
Sinkholes are depressions in the land surface caused by subsurface conditions. Naturally occurring sinkholes are largely associated with karst topography, where changing groundwater conditions may cause a sudden loss of stability in the roofs of cavernous openings, causing sudden sinkholes. Karst topography is generally found only in western portions of Virginia. The GWRC region is not considered to be within a karst area.

More likely within the GWRC region are sinkholes caused by the failure of underground infrastructure, principally stormwater drains and conveyances. Breaks in underground storm pipes can cause sub-surface erosion that may open caverns to an extent that surface features can no longer be supported, resulting in a sinkhole. Sinkholes can form suddenly and depending on their size and location can cause significant damage to infrastructure in their vicinity. Sinkholes in the area are more likely to be caused by failed underground infrastructure and in general no one particular jurisdiction is more at risk than any other.

A landslide is the movement of any mass of rock, soil, or debris down a slope. This process is driven by gravity and may occur instantaneously or very slowly over time. Landslides are usually triggered by heavy rainfall, rapid snow melt, stream incision, or earthquakes. Certain man-made changes to the land, such as slope modification or drainage alteration, can greatly increase the likelihood of landslides. In terms of magnitude or severity, landslides are capable of damaging buildings, rupturing gas, water, and sewer lines, and knocking out power and telephone lines while blocking transportation routes. The steady urbanization of the GWRC region makes the possibility of landslides caused by man made changes to slopes by the location of buildings and infrastructure, including roads, on or near steep slopes, more common.

Extent and Magnitude

Landslides are Virginia's most widespread geologic hazard. The most disastrous landslide events are associated with heavy rainfall along the steep slopes of the Blue Ridge Mountains and the Appalachians, but slumping, sliding, and creep can occur even on fairly gentle slopes if local conditions exceed the natural stability of the site. Areas that are prone to mass movement include areas of previous landslides; the bases of steep slopes, particularly slopes burned by forest and brush fires; the margins of drainages; and developed hillsides, especially where septic systems are used. Research in North Carolina has revealed that about fifty-six percent (56%) of recent landslides happened on slopes that had been altered in some way by development.



Virginia Landslide Risk. *(red=high, orange=moderate-high, yellow=moderate-low, green=low)* ***VDMME.***

Location

Landslide potential is considered high in Stafford County, moderate in King George County and low in Spotsylvania County, Caroline County and the City of Fredericksburg. Areas of urban growth, where grading, retaining walls, or underground stormwater piping are used, are at increased risk for landslide and sinkhole hazards.

Past Occurrences

Data regarding past occurrences of sinkholes and landslides in the GWRC region is not standardized or consistently reported. Occasional events have included a September 2011 landslide involving the failure of a constructed slope in the Austin Ridge subdivision in Stafford County, and a November 2012 sinkhole caused by failed underground infrastructure that briefly closed lanes of US 17 in Stafford County.

Likelihood of Future Occurrences

Sinkholes and landslides are considered to be low probability, and potentially high-impact events. Although future occurrences of either hazard are possible in the region, determining the probability of such events is not possible given the number and varied scope of contributing factors.

4.1.6 - Flooding

Description

Flooding is the most frequent and most costly natural hazard in the United States. Nearly 90 percent (90%) of presidential disaster declarations result from natural events in which flooding is a major component. Excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto adjacent floodplains, i.e., the lowlands adjacent to rivers, lakes, and oceans that are subject to recurring floods. While many floodplain boundaries are mapped by FEMA's National Flood Insurance Program (NFIP), floods sometimes go beyond the mapped floodplains or change courses due to natural processes (e.g., erosion, sedimentation, etc.) or human development (e.g., filling in floodplain or floodway areas, increased imperviousness within the watershed from new development, or debris blockage including cars, trailers, and propane tanks). All of the jurisdictions in the GWRC are mapped by the NFIP, and all participate in the NFIP (note that the Towns of Bowling Green and Port Royal participate through Caroline County). In addition, Stafford County participates in the Community Rating System (CRS Class 8). Since the floodplains in the United States are home to over nine million households, most property damage results from inundation by sediment and debris-filled water.

There are four basic types of floods that afflict Virginia's communities, depending on the region of the state examined: coastal flooding (tidal and storm surge), urban flooding, flash flooding, and riverine flooding. The GWRC region is most susceptible to urban flooding and flash flooding. Low-lying areas adjacent to rivers, streams, and creeks are susceptible to riverine flooding. In addition, portions of the Potomac and Rappahannock Rivers in the region are subject to tidal flooding. Urban flooding often occurs in highly impervious (pavement/rooftops/concrete) areas. Impervious surfaces do not allow water to be absorbed into the ground and increase the speed and amount of water that "runs off" property. When areas are without proper drainage, or storm drains become clogged, streets become streams and water gathers in low-lying areas. With enough rain, underpasses can rapidly fill, trapping motorists; streets can rapidly accumulate enough water to submerge cars or carry them wherever the water flows.

Flash floods occur quickly and in a short period of time. Rain falls at such a high rate that water does not have time to be absorbed into the ground. It flows downhill into ditches, lowlands and small streams. As the heavy rain continues, ditches overflow, drains back up, water ponds in lowlands and streams rise over their banks. Streams and creeks can become raging rivers in just minutes. Motorists are often surprised by flash floods, and unfortunately often become victims of the flash flood. More than half of flash flood deaths in the United States occur in automobiles.

Riverine floods occur when heavy rains fall over a large area. In many cases in Virginia, it begins as widespread flash flooding of small streams. Approximately 60 percent (60%) of Virginia's river floods begin with flash flooding from tropical systems passing over or near the state. Riverine flooding also occurs because of successive rainstorms. Rainfall from any one storm may not be enough to cause a problem, but with each successive storm's passage over the basin, rivers rise until eventually they overflow their banks. If it is late winter or spring, melting snow in the mountains can produce added runoff that can compound flood problems.

Extent and Magnitude

Even short periods of heavy rainfall can cause flooding throughout the region. The majority of severe flooding is caused by intense rainfall resulting from localized thunderstorms. The effects are generally

aggravated in areas where man-made and natural obstructions in the floodplain impeded the passage of large flows.

Location

Flooding of vacant land or land that does not have a direct effect on people or the economy is generally not considered a problem. Flood problems arise when floodwaters cover developed areas, locations of economic importance, infrastructure, and any other critical facility. The flash flooding and urban flooding that occurs is often brought on by powerful thunderstorms that can dump one to four inches of rain in a matter of a few hours. Small creeks and streams as well as overtaxed drainage systems often cannot cope with the quick influx of rain waters. Their banks can quickly overtop resulting in dozens of flooded roads as well as personal and private property damage. See maps below for identified local flood zones.

Past Occurrences

There have been over twenty significant flash floods in the GWRC area between 1996 and 2016, which demonstrates the GWRC area's susceptibility to future flooding events. The Rappahannock River has had four major floods since the early-1970's. These floods exceeded the flood stage by two to 21 feet. The "flood stage" refers to the height of the river or stream at which flooding and property damage begins. Once the water rises above flood stage, damage is expected.

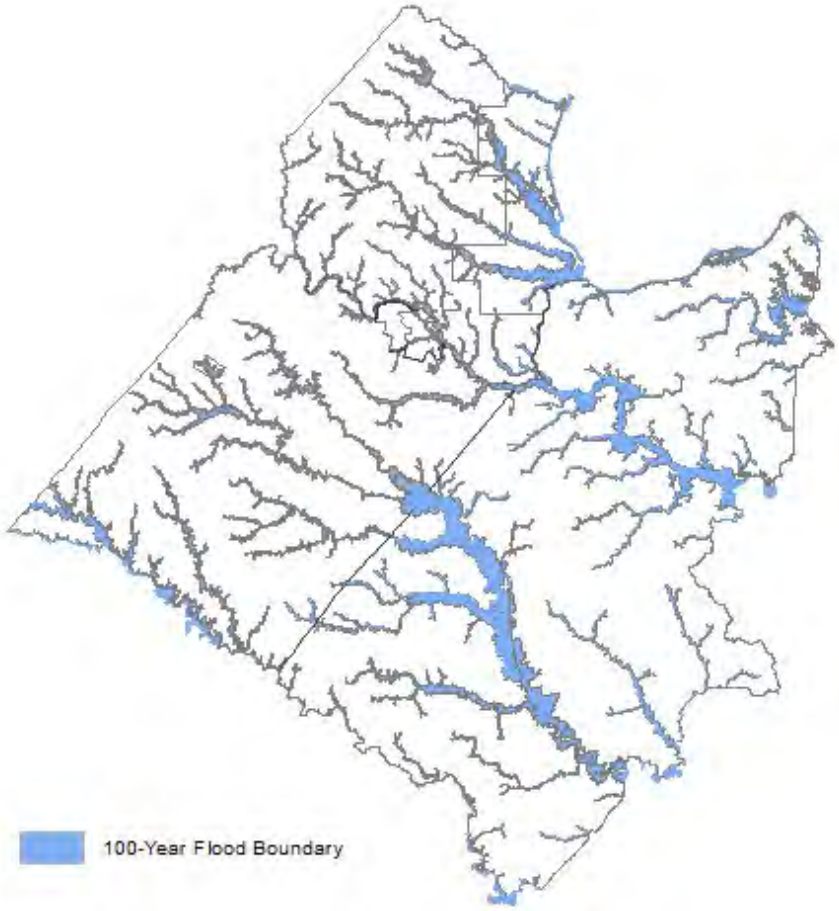
Under the right conditions, flood events can be exceptionally damaging. One such event occurred on February 22, 2003. Powerful rains coupled with a large amount of snowmelt produced flash flooding over the Spotsylvania, Fredericksburg and Stafford areas. The rain washed out dozens of roads and caused the closure of others because of standing water. There were also several reports of uprooted trees as well as personal and private property damage.

See Section 4.3 for historical flooding data for each GWRC community.

Likelihood of Future Occurrences

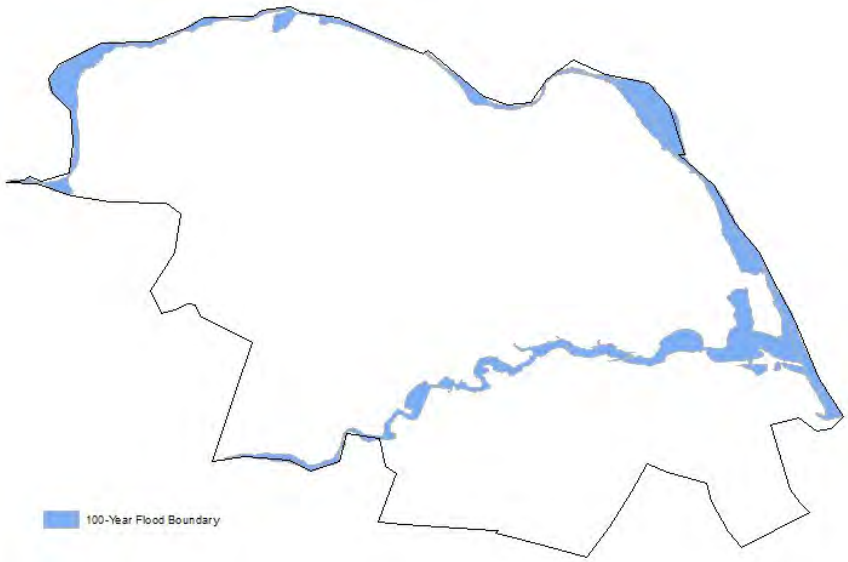
The terms "10-year," "50-year," "100-year," and "500-year" floods are used to describe the estimated probability of a flood event happening in any given year. A 10-year flood has a 10 percent probability of occurring in any given year, a 50-year event has a two percent probability, a 100-year event has a one percent probability, and a 500-year event has a 0.2 percent probability. While unlikely, it is possible to have two 100-or even 500-year floods within years or months of each other.

The potential for flooding can change and increase through various land use changes and changes to the land surface. A change in environment can create localized flooding problems inside and outside of natural floodplains through the alteration or confinement of natural drainage channels. These changes can be created by human activities or by other events, such as wildfires, earthquakes, or landslides.



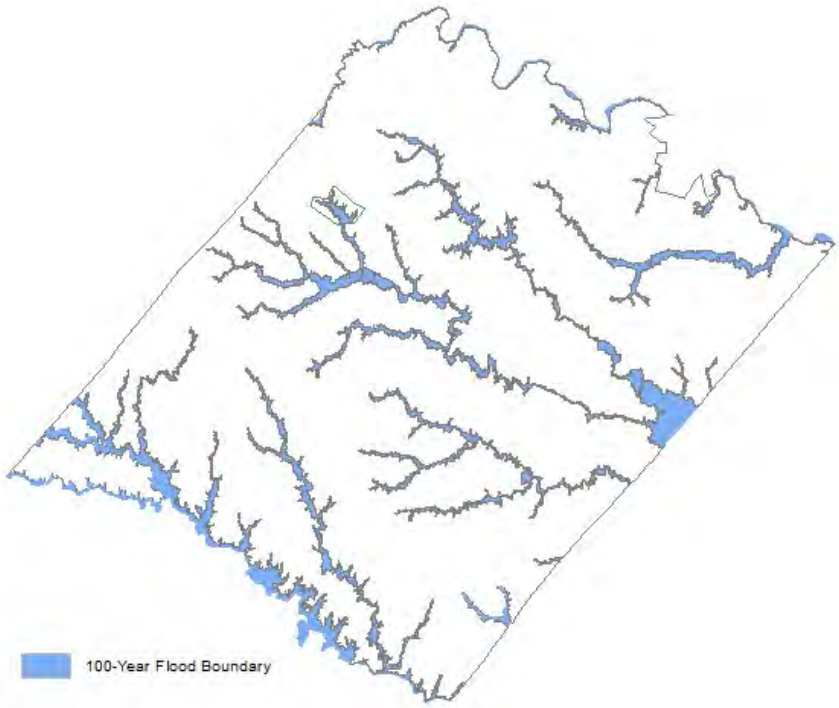
Identified 100-Year Flood Boundary; George Washington Region. FEMA.

Identified 100-Year Flood Boundary; Caroline County. FEMA.



Identified 100-Year Flood Boundary; City of Fredericksburg. FEMA.

Identified 100-Year Flood Boundary; King George County. FEMA.



Identified 100-Year Flood Boundary; Spotsylvania County. FEMA.

Identified 100-Year Flood Boundary; Stafford County. FEMA.

4.1.7 - Non-Rotational Wind (Hurricanes and Thunderstorms)

Hurricanes and Tropical Storms

Description

Hurricanes and tropical storms, as well as tropical depressions, are all tropical cyclones. According to the National Hurricane Center (NHC), once they have 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 wind, all of which can cause significant damage. These storms can last for several days, and therefore have the potential to cause sustained flooding and high wind conditions. Of particular importance to

communities susceptible to hurricane damage is the track of an approaching storm. Proximity and direction of hit are important when determining impacts and subsequent damage from the storm.

Extent and Magnitude

Hurricane season in the North Atlantic runs from June 1st until November 30th, with the peak season between August 15 and October 15. The average hurricane duration is 12 to 18 hours. Wind speeds may be reduced by 50 percent within 12 hours. These storms are capable of producing a large amount of rain in a short period; as much as six to 12 inches of rain has occurred within a 12 to 16 hour period. The entire GWRC region is at risk for hurricane damage.

The Saffir-Simpson scale is used to classify the intensity of hurricanes based on wind speed and barometric pressure measurements. The National Weather Service uses the scale to predict potential property damage and flooding levels from imminent storms. The scale is outlined in the following table.

Saffir-Simpson Scale and Typical Damages

Category	Sustained Wind Speeds (mph)	Tidal Surge (ft)	Pressure (mb)	Typical Damage
Tropical Depression	<39	--	--	
Tropical Storm	39-73	--	--	
Hurricane 1	74-95	4-5	> 980	*Minimal* – Damage is done to shrubbery and trees, unanchored manufactured homes are damaged, some signs are damaged, no real damage is done to structures on permanent foundations.
Hurricane 2	96-110	6-8	965-980	*Moderate* – Some trees are toppled, some roof coverings are damaged, and major damage is done to manufactured homes.
Hurricane 3	111-130	9-12	945-965	*Extensive Damage* – Large trees are toppled, some structural damage is done to roofs, manufactured homes are destroyed, and structural damage is done 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 is considerable and widespread, window and door damage is severe, there are extensive glass failures, some buildings fail completely.

Source: National Weather Service, National Hurricane Center.

Location

Numerous hurricanes and tropical storms occur along the eastern seaboard each year, with direct landfall occurring somewhere along the eastern United States approximately once every three years. While the region is somewhat protected from the full strength of a hurricane, its expansive nature makes the region

vulnerable to high winds, flooding, and tornadoes that often accompany these other extreme weather events.

Past Occurrences

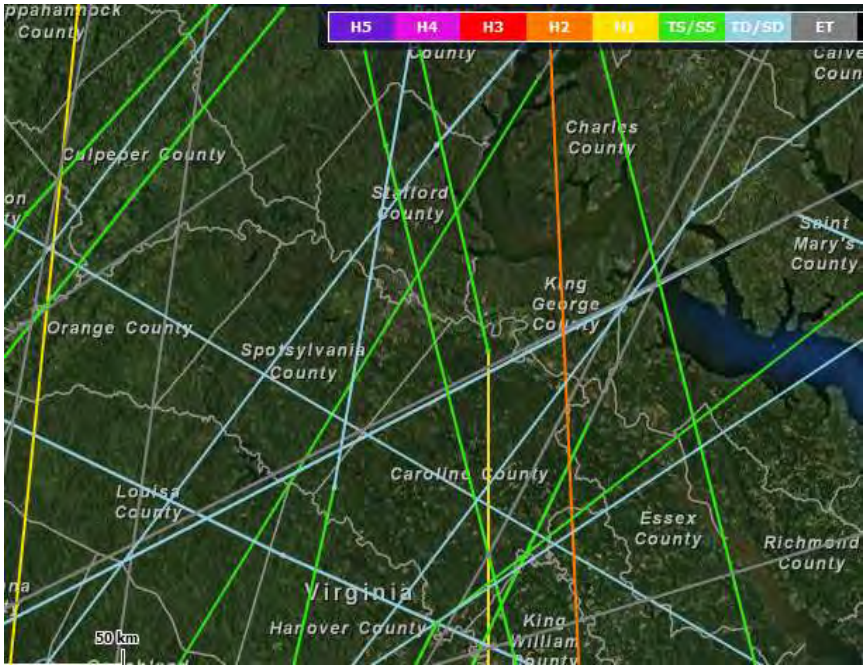
Historically, hurricanes have come close enough to Virginia to produce hurricane force winds (>74 mph) approximately three times every twenty years. Recently, the GWRC region's communities were damaged by Hurricanes Floyd (September, 1999), Isabel (September, 2003) and Jeanne and Gaston (2004), Ernesto (2006), and Irene (2011). Hurricane Floyd moved through the area dropping four to five inches of rain within 24 hours and generated winds in excess of 40 mph. Trees and power lines were knocked down, roads flooded; over 5,500 homes were left without power.

Hurricane Isabel was much more destructive. Its impact on the Commonwealth of Virginia was staggering; resulting in $1.6 billion in damages with over 1,186 homes and 77 businesses completely destroyed 9,110 homes and 333 businesses with major damage and over 107,000 homes and 1,000 businesses with minor damage. Hundreds of power lines were blown down leaving almost two million electrical customers without power. Crop losses were calculated to be $59.3 million, with another $57.6 million in damages to farming infrastructure.

Tropical Depression Ernesto struck the region on August 29, 2006. King George and Caroline County among others were declared as major disaster areas. There were 7 fatalities with total damages (not including economic losses) exceeding $118 million. Over six hundred homes were destroyed or damaged. The storm surge and excessive rain led to flooding throughout Northern Virginia.

Tropical Storm Lee was a broad tropical disturbance originating in the Gulf of Mexico in the beginning of September and working its way north. The storm struck the state of Virginia on September 8, 2011, causing widespread damage. Nationally, the storm caused several deaths spurred numerous tornadoes. Within Virginia, the storm caused millions of dollars' worth of damages. On November 17, 2011, the President declared a Major Disaster in Virginia due to effects of damage from Tropical Storm Lee. This action makes Public Assistance available for reimbursement of disaster related costs.

In evaluating the localized threat of hurricanes and tropical storms to the region, the committee analyzed hurricane track data from the National Oceanic and Atmospheric Association (NOAA) from 1851 to 2008 to identify storms that have posed a threat to the area. Based on these data, 30 storms, including hurricanes, tropical storms, tropical depressions, and extratropical storms tracked through or impacted the GWRC region during that time period. Of the 31 storms, eleven were tropical depressions and extra-tropical storms (winds <39 mph), and eleven were tropical storms (winds of 39-73 mph). In addition, the 2004 hurricane season was one of the most severe in recorded history. Five separate tropical cyclones (Charley, Frances, Ivan, Jeanne, and Gaston) of varying magnitude hit the eastern and Gulf coasts of the United States. It should be noted that the GWRC communities have been affected by storms that did not track across its borders. High winds and large rain events associated with passing storms have caused localized damage in the past. Examples include Hurricanes Camille (1969), Agnes (1972), Bertha (1996), Floyd (1999), and Gaston (2004).



Historic Hurricane Tracks; GWRC Region. NOAA.

Past Hurricanes in Vicinity of GWRC Communities, 1950 to 2016

Month, Year	Name
1954	Hazel
1960	Camille
1979	Bob
1981	Bret
1999	Floyd
2000	Gordon
2003	Isabel
2004	Charley and Bonnie
2004	Frances
2004	Ivan
2004	Jeanne
2004	Gaston
2005	Cindy
2006	Ernesto
2008	Hanna
2011	Irene

Likelihood of Future Occurrences

VDEM rates Virginia's overall wind risk as "High," and the GWRC communities are no exception. Historical occurrences of high winds generated by hurricanes and tropical storms are a strong indication of future events. With proper planning, the impact and amount of damage caused by high winds can be lessened. According to *Minimum Design Loads for Buildings* (ASCE 7-05), the design wind speed for the GWRC region is less than 90 mph.

Thunderstorms

Description

Thunderstorms are defined as localized storms, always accompanied by lightning, and often having strong wind gusts, heavy rain and sometimes hail or tornadoes. Thunderstorms can produce a strong out-rush of wind known as a downburst or microburst, or straight-line winds which may exceed 120 mph, also known as "derecho storms." These storms can overturn mobile homes, tear roofs off of houses and topple trees.

Extent and Magnitude

Approximately 10 percent of the thunderstorms that occur each year in the United States are classified as severe. A thunderstorm is classified as severe when it contains one or more of the following phenomena:

- Hail measuring ¾ inch or greater;
- Winds gusting in excess of 50 knots (57.5 mph); or
- A tornado.
- A *severe thunderstorm watch* is issued by the National Weather Service when the weather conditions are such that a severe thunderstorm is likely to develop. This is the time to locate a safe place in the home and to watch the sky and listen to the radio or television for more information.
- A *severe thunderstorm warning* is issued when a severe thunderstorm has been sighted or indicated by weather radar. At this point, the danger is very serious and it is time to go to a safe place, turn on a battery-operated radio or television, and wait for the "all clear" from authorities.

Among the hazards that thunderstorms can bring is ground striking lightning. Lightning can strike up to 10 to 15 miles from the rain portion of the storm. The lightning bolt originates from the upper part of the thunderstorm cloud known as the anvil. A thunderstorm can grow up to eight miles into the atmosphere where the strong winds aloft spread the top of the thunderstorm cloud out into an anvil. The anvil can spread many miles from the rain portion of the storm, but it is still a part of that storm. Lightning from the anvil may strike several miles in advance of the rain. Lightning bolts may also come from the side or back of the storm, striking after the rain and storm may seem to have passed or hitting areas that received little or no rain.

Location

The entire GWRC region is at risk for thunderstorm damage.

Past Occurrences

There have been seven people injured and well over $100,000 in property damage caused by lightning strikes in the GWRC since 1993. The majority of the damage caused by lightning in the area involved home strikes, small brush fires, power line failures and animal deaths. These instances typically cause only minor property damage, but may also leave customers without electrical power for periods ranging from hours to days. Like many other natural hazards that can affect a very small area but have a large impact on the area affected, air-to-ground lightning strikes are likely to occur far more frequently than current statistics would indicate.

4.1.8 - Tornadoes (i.e. Rotational Wind)

Description

Tornadoes are one of nature's most violent storms. In an average year, approximately 1,000 tornadoes are reported across the United States, resulting in 80 deaths and over 1,500 injuries. A tornado is a rotating column of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one mile wide and 50 miles long.

Extent and Magnitude

A tornado's destructive power (magnitude) is measured using the Fujita Damage Scale (see table below).

Fujita Tornado Damage Scale

Scale	Wind Estimate (MPH)	Typical Damage
F0	< 73	Light Damage, some damage to chimneys; branches off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate Damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable Damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe Damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating Damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.

Source: Fujita 1971, NOAA, http://www.spc.noaa.gov/faq/tornado/f-scale.html

Location

In Virginia, most tornadoes occur from April to October. However, tornadoes can strike at any time during the year. Tornadoes are not more likely to strike one jurisdiction over another in the GWRC area. Each jurisdiction is considered to have roughly the same probability of experiencing a tornado.

Past Occurrences

A tornado's intense power often destroys homes, downs power lines, and can cause significant tree damage. One such instance occurred on July 24, 1999 in the GWRC area. An F1 tornado moved through 20 miles of the area. It uprooted and snapped hundreds of trees and power lines, did minor damage to several homes, businesses, and farms, and tore the roof off of a local school. Although there were no injuries reported, damages totaled over $1.0 million.

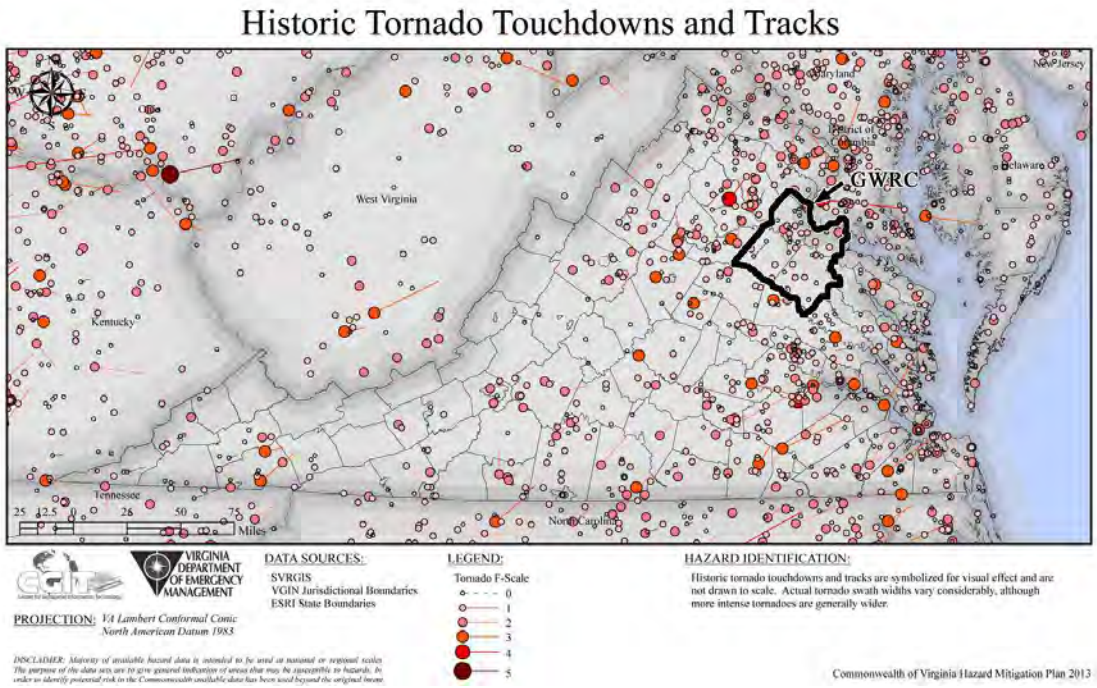
The GWRC area has experienced 17 tornadoes since 1960, with damages totaling nearly $2.0 million. Most of the tornadoes in the area are of a magnitude F0 – F1 (15 since 1960). However, two tornadoes in the area have reached a magnitude of F2 – F3.

Hurricanes Frances and Charley of the 2004 hurricane season spawned numerous tornadoes in the region, three of which were confirmed by the National Weather Service. As detailed information relating to damage and wind speed intensity on the Fujita scale become available over time, the region's communities may wish to update this portion of the plan. As described in the section discussing lightning strikes, it is important to note that tornadoes other than the ones reported here might have occurred in the region over time. However, unconfirmed tornadoes cannot be included in the body of tornado statistics.

See Section 4.3 for historical tornado data for each GWRC community.

Likelihood of Future Occurrences

Every locality in the GW Region has a medium-high to high tornado risk compared with the rest of the state; note that this risk is relatively low compared to other regions of the US.



Historic Tornado Events. VDEM.

4.1.9 - Winter Storms and Nor'easters

Winter Storms

Description

Winter storms can combine different types of precipitation including snow, freezing rain, and ice, as well as high winds, and cold temperatures. These storms can range from being a minor inconvenience to crippling, and potentially life-threatening events. Winter storms can be very disruptive, particularly in areas where they do not occur frequently. Strong winds with these intense storms can knock down trees, utility poles, and power lines. Heavy accumulations of ice can also bring down trees, electrical wires, telephone poles and lines, and communication towers. These storms can disrupt communications and power for days while utility companies work to repair the potentially extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Heavy snow can immobilize a region and paralyze a community, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. The cost of snow removal, repairing damages, and loss of business can also have a significant economic impact on communities.

Extent and Magnitude

Winter storms and freezing rain have the potential to impact the region as a whole. These events typically occur between December and March.

Location

It is quite common for the rain-snow line to fall within, or near, the GWRC region. Heavy snow often falls in a narrow 50-mile wide swath approximately 150 miles northwest of the low-pressure center (see table). The GWRC area often finds itself within this 50-mile wide swath of dangerous winter weather.

Past Occurrences

It is also not uncommon for the GWRC area to experience sleet, freezing rain and ice storms at a rate of approximately 2 to 3 events per winter. Significant past winter storm events are summarized in the table below:

Significant Winter Storm Events – GWRC Region

Date	Description
January 6-8, 1996	Much of the eastern seaboard received 1 to 3 feet of snow during the "Blizzard of '96." Wind gusts of over 50 mph were common and resulted in blizzard conditions for much of the east coast, including Virginia. Many areas of Virginia received over 20 inches of snow. Numerous accidents and flood related damages were reported in the area, along with 13 deaths in Virginia. Virginia, along with Ohio, Pennsylvania, Maryland, West Virginia and New York were declared Presidential Disaster Areas. All totaled, the blizzard and resulting flooding killed an estimated 187 people and caused approximately $3 billion in damages along the eastern seaboard.
January 25, 2000	A significant winter storm dumped over one foot of snow across much of central and eastern Virginia, with isolated amounts close to two feet. Caroline County reported over 12 inches of accumulation. There was also significant blowing and drifting of snow as winds gusted over 30 mph during the storm. This resulted in very hazardous conditions and snow drifts of 3 to 5 feet.
February 22, 2001	A winter storm dropped 2 to 5 inches of snow in the GWRC area. The amount of snow itself is not as significant as the amount of time in which it dropped. Several areas received a brief period of heavy snow at the beginning of the event, which created whiteout conditions. An interstate pileup of record proportions (131 vehicles) occurred in Stafford County on I-95 around 10:30 AM. Across Virginia, officers responded to 1520 crashes involving a total of 400 vehicles.
January 02, 2002	A winter storm dumped 7 to 8 inches of snow in Caroline County and other areas across central and eastern Virginia. Local law enforcement agencies reported numerous accidents and most schools were closed through January 4th due to slippery road conditions.
February 06, 2003	A winter storm produced 4 to 7 inches of snow across the piedmont of central Virginia and the Virginia Northern Neck. Some of the highest snow amounts in the region occurred in Caroline County. Very slippery road conditions lasted through February 7th, resulting in numerous accidents and school closings.

February 15, 2003	A winter storm produced 4 to 9 inches of snow, along with sleet and freezing rain, across central and eastern Virginia. Caroline County had some of the highest snow amounts with 9 inches of accumulation. Very hazardous road conditions lasted through February 18th. Local law enforcement agencies reported several accidents and schools in the area were closed.
February 5, 2004	A winter storm produced one to two tenths of accumulated ice on roads and surfaces. The ice coated surfaces downed power lines and felled trees. This resulted in school closures/delays, automobile accidents, and scattered power outages. In Stafford County, an automobile accident claimed the lives of two students as they travelled to school. A third student was seriously injured.
December 5, 2005	A winter storm produced 4 to 6.5 inches of heavy snow in Northern Virginia. The storm was a heavy wet snow that caused trees to fall and property damages of 40k.
February 12, 2006	A historic snowstorm occurred through the night of February 11th to the morning of the 12th in Northern and Central Virginia. Snowfall accumulation was between 8 and 14 inches. There were several instances of downed powerlines and trees due to the heavy snow, causing outages in some areas. Total outages were reported to be around 300,000 in the Greater Washington/Baltimore region. Amtrak reported major delays. Total property damage was estimated at 250k.
March 1, 2009	A winter storm produced up to nine inches of snow in Spotsylvania and Stafford Counties.
December 18, 2009	A winter storm produced between 19 and 23 inches of snow across the counties of Stafford and King George. President Obama and FEMA would declare this storm a natural disaster in February of the following year. The Commonwealth of Virginia received over 29 million in financial assistance to be spread across 48 counties and 10 independent cities for public assistance, snow removal, and hazard mitigation.
January 30, 2010	A winter storm produced between 5 and 12 inches of snow across Northern Virginia.
February 5, 2010	A winter storm produced between 8 and 17 inches across the region. Power outages were reported throughout the area due to the weight of the snow on trees and power lines. Total damage was estimated at 5k. Governor McDonnell declared a state of emergency and several schools in the area were closed through the following week.
February 12, 2014	Intensifying low pressure moving northward along the coast produced between four and ten inches of snow across portions of central and eastern Virginia from Wednesday afternoon, February 12th into Thursday evening, February 13th. Snowfall amounts were generally between four inches and eight inches across the GWRC region.
February 16, 2015	Low pressure moving from the Southern Plains east northeast and off the Mid Atlantic Coast produced between four inches and nine inches of snow across central, south central and eastern Virginia from Monday afternoon, February 16th through early Tuesday morning, February 17th. Snowfall amounts were generally between four inches and seven inches across the GWRC region.
January 22, 2016	Strong Low Pressure moving from the Southeast United States northeast and off the Mid Atlantic Coast produced between eight and nineteen inches of snow and strong winds across central Virginia. Snowfall totals were generally between 10 inches and 18 inches across the GWRC region. Snowfall amounts between 17 and 24 inches were reported across Spotsylvania County. Stafford County reported snowfall amounts between 15 and 24 inches.

Source: Watson 2004. NCDC 2016.

Likelihood of Future Occurrences

Records of past winter storm events in the GWRC region suggest a near annual recurrence interval. Since 2003, there have been sixteen recorded winter events over a period of fourteen years. These storms exceeded five inches of accumulated snow or less than an inch of accumulated ice. Winter storms in the region have knocked down power lines, created slippery road conditions resulting in automobile accidents and fatalities, school closures, and delayed commutes. A particular storm in 2009 was declared as a natural disaster by the Commonwealth of Virginia and FEMA, resulting in over $29 million in financial assistance to the state for cleanup and payouts to private and public utility damages. The region has identified the probability of occurrence for winter storms as high.

Nor'easters

Description

Northeasters are slow moving, low-pressure systems that typically form either in the Gulf of Mexico or in the Atlantic Ocean. Although typically associated with winter storm events, Northeasters can occur during anytime of the year. Low-pressure systems develop into storms that bring strong northeast winds, heavy rains/precipitation and storm surge to coastal areas. The winds and storm surge resulting from northeasters are generally less intense than that of hurricanes. However, unlike hurricanes, these storms can linger for several days over a given area allowing larger accumulations of precipitation as well as more damage to structures, since they are exposed to wind and flooding for longer periods of time.

Extent and Magnitude

The Dolan-Davis Scale, as presented in the table below, was developed to identify and classify the damages that may occur during these storm events. This scale is a useful tool for estimating the damage potential of a northeaster. This scale is especially useful to those communities in the GWRC region that experience tidal flooding.

Dolan-Davis Northeaster Intensity Scale (Davis and Dolan, 1993)

Storm Class	Beach Erosion	Dune Erosion	Overwash	Property Damage
1 (Weak)	Minor changes	None	No	No
2 (Moderate)	Modest; mostly to lower beach	Minor	No	Modest
3 (Significant)	Erosion extends across beach	Can be significant	No	Loss of many structures at local level
4 (Severe)	Severe beach erosion and recession	Severe dune erosion or destruction	On low beaches	Loss of structures at community-scale
5 (Extreme)	Extreme beach erosion	Dunes destroyed over extensive areas	Massive in sheets and channels	Extensive at regional-scale; millions of dollars

Source: North Carolina Division of Emergency Management, http://www.dem.dcc.state.nc.us/mitigation/noreaster.htm

Location

Northeasters typically form either in the Gulf of Mexico or in the Atlantic Ocean. As a result, the GWRC region is prone to experiencing the effects of Atlantic forming storms. Because these storms are very large they are likely to affect the entire eastern seaboard.

Past Occurrences

The table below is a listing of historic northeasters for the GWRC region.

Historic Northeasters - GWRC Region

Date	Description
February 10-11, 1983	Known as the "Blizzard of '83", this storm event covered an unusually large area of Virginia with more than a foot of snow. The storm set a new 24-hour snowfall record in Lynchburg with 14.6 inches, Roanoke with 18.6 inches and Richmond with 16.8 inches. Richmond received 18 inches total and parts of Northern Virginia measured as much as 30 inches on the ground. Winds gusted over 25 mph all day on February 11 in the Richmond area causing three-foot high drifts. This was the third heaviest snowfall on record for Richmond for the last 100 years. The cost of clearing the snow from state roads came to $9 million.
February 2-3 and February 16, 1996, Storms	A continuing series of Alberta clippers followed by strong Northeasters struck the Commonwealth. The storm on February 2-3 dropped one to two feet of snow from Charlottesville to Fredericksburg and across the Northern Neck. 6 to 10 inches of snow fell to the north of the heavy snow band and significant icing occurred to the south of the band. Some counties along the North Carolina border saw approximately half of its population lose power. The ice caused approximately a half million dollars in damage and caused widespread disruptions in the Hampton Roads area. Following the fresh snow and ice came a cold wave from the 3rd through the 6th with many areas dropping below zero. On the 5th, several places set new records. Lynchburg set a new all-time record low temperature reaching -10° F and Burkes Garden recorded -22° F, which is one of the coldest temperatures ever recorded in Virginia. On the 16th, another Northeaster moved up the coast dumping 6 to 12 inches of snow in a swath across Virginia from Nottoway to Fredericksburg with Charlottesville on the west side of the heavy band and Richmond on the east side.
Winter of 1995-1996	Much of Virginia, mainly north and west of Richmond, had either a record seasonal snow total or a top three snowfall for the 20th century. Lynchburg set a new record with 57 inches of snow and Dulles with 62 inches. Blacksburg had 76 inches. Bluemont recorded 87 inches. Fredericksburg and the Northern Neck saw nearly 60 inches of snow. Roanoke recorded its third snowiest season with 53.4 inches.
January 24-25, 2000	The Northeaster spread heavy snow into Virginia during the night of the 24th and through the 25th. Storm warnings were posted for the late news on the 24th, but those who went to bed early without catching the news were startled to see the heavy white stuff falling in the morning. Several inches of snow was on the ground at daybreak, with winds gusting at 25 to 45 mph creating blizzard conditions in some areas. The region was at a standstill. Airports and transit systems were shut down. Schools were closed. Federal, state and county government offices were closed or quickly closed once the full impact of the storm was realized. Some federal employees in Northern Virginia who begin their commutes well before the government shutdown at 7 am were left battling the storm to attempt to return home. Drifts of four to five feet were common. Snow mixed with sleet and freezing rain in some of the eastern counties.
December 18–21, 2009	A nor'easter that formed over the Gulf of Mexico developed into a winter storm affecting much of the East Coast. This snowstorm resulted in a federally declared disaster.

Date	Description
February 4–7, 2010	A nor'easter affecting northern Virginia created a snowstorm that was a federally declared disaster. The Lincoln weather station near Purcellville, Virginia in Loudoun County reported 34 inches of snow on February 6, 2010.

Source: VDEM 2016.

Likelihood of Future Occurrences

According to the neighboring emergency management agency of North Carolina, the frequency of major northeasters (class four and five on the Dolan-Davis Scale) has increased in recent years.

4.2 – Climate Change, Criticality, and Probability of Hazards

Scientific evidence for climate change is a hot topic in many areas of government, as well as in research and industrial sectors. While this plan does not profess to settle any debate over evidence for, or causes of, measured or forecast climate change, it does take the position that any potential risk should be taken seriously, and that potential responses and mitigations should be planned for.

The potential risks of climate change can have broad effects on the GWRC region, including on its public health, infrastructure, agriculture, tourism, and emergency services. When considering the impacts of natural hazards on local jurisdictions it will be important to evaluate the potential for increased hazard events in the future, as well as how local, regional, state, and federal resources can be used to reduce or eliminate these risks. The GWRC region is not alone in considering these risks; studies, programs, and initiatives are underway or under consideration in a variety of other areas.

The Virginia Governor's Commission on Climate Change

The Virginia Governor's Commission on Climate Change was initially established in 2007, and its work further updated in 2015. The Commission was comprised of more than 40 citizens of the Commonwealth, including scientists, economists, environmental advocates, and representatives from the energy, transportation, building, and manufacturing sectors. The group was tasked with evaluating the potential effects of climate change on the state and providing recommendations for eliminating or mitigating these effects through various actions across a range of topics, services, and industries. Among the tasks charged to the Commission were to:

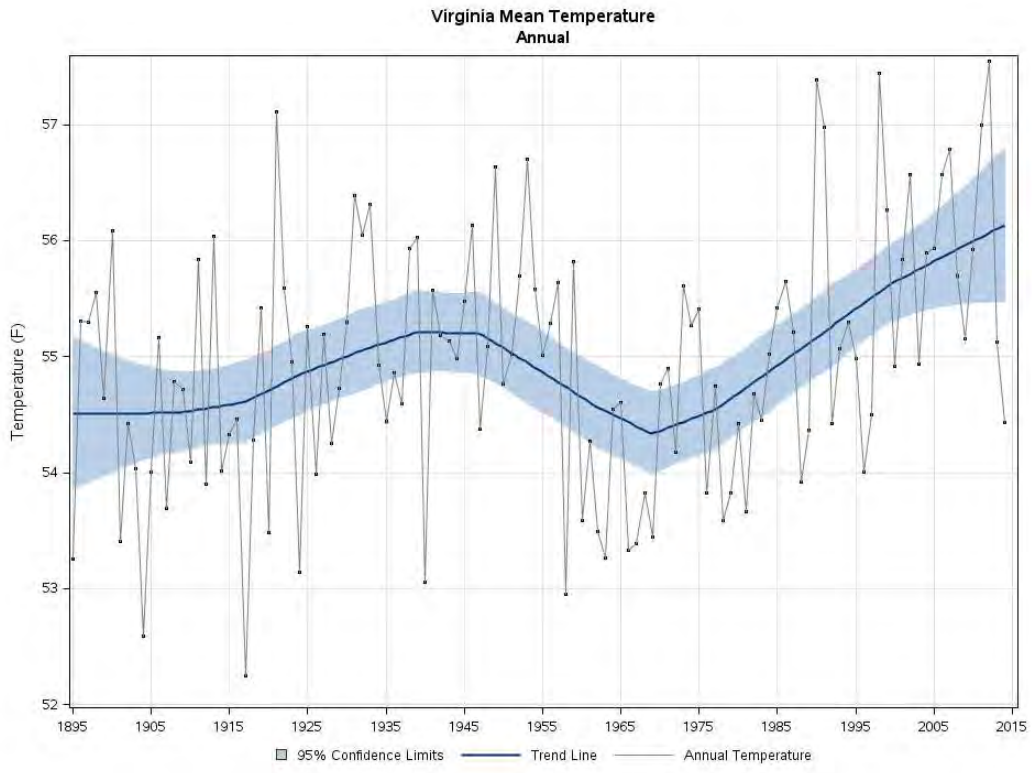
1. Evaluate expected impacts of climate change on Virginia's natural resources, the health of its citizens, and the economy, including the industries of agriculture, forestry, tourism, and insurance.
2. Identify what Virginia needs to do to prepare for the likely consequences of climate change.
3. Identify climate change approaches being pursued by other states, regions, and the federal government.

The recommendations of the Governor's Commission on Climate Change covered a variety of topics related to both the causes and effects of climate change, including recommendations that address steps Virginia should take to plan for and adapt to climate change impacts that cannot otherwise be avoided, including direct adaptive responses, further research, and increased capacity and coordination within state and local government. Specifically, the Commission directs that: "Virginia state agencies and local governments will prepare for and adapt to the impacts of climate change that cannot be prevented."

Changes in Climate

Evidence of climate change, as well as forecasts of continuing change, affect several areas of weather and environment, including high and low temperatures, sea level, precipitation, and the frequency of extreme weather events. As a part of the Climate, Environment, and Readiness (CLEAR) Plan, the University of Mary Washington Department of Earth and Environmental Sciences has shared the following findings, drawn in part from the 2013 Intergovernmental Panel on Climate Change:

- Each of the last three decades has been successively warmer than any preceding decade since 1850.
- By the end of the 21st century, global temperature change is likely to exceed 2.7 degrees Fahrenheit.
- Sea level has risen more drastically since the mid-19th century than it had during the previous two millennia.
- During the 21st century, sea level is expected to rise faster than it did from 1971 to 2010, due to increased ocean warming and increased melting of glaciers and ice sheets.



Mean Annual Temperature Trend. Virginia, 1895 to 2015. NOAA.

Climate Change Impacts

The above changes in temperature and sea level can lead to increased risk of many of the natural hazards identified in this plan, including drought, wildfire, flooding, and severe storms. The George Washington Region should expect the following in the future:

- More frequent, and more intense, precipitation events punctuated by deeper episodes of drought.
- Drier winter and summer seasons, which could deplete reservoirs and challenge agricultural production.
- Increased storm surges along tidal portions of the Potomac and Rappahannock rivers, caused by rising sea level and stronger Atlantic tropical storms.
- Stronger storms coming at a greater frequency, which may threaten lives, damage infrastructure and cause significant power outages.
- Increasing summer heat waves that could threaten public health.

Even gradual changes in climate have the potential to increase the frequency and severity of the natural hazards cataloged by this plan. Localities in the GWRC region should be aware of these risks, and that past levels of readiness may not be sufficient in the future due to 1. Increased natural disaster frequency as a result of climate change, and 2. Local growth that puts more people, businesses, and critical facilities in the path of natural hazards.

Multi-Hazard Events

While this plan investigates individual hazards and their occurrences, it should be noted that hazards do not always happen in isolation. Hurricanes may cause damage based on both high winds and flooding from heavy rains. Immediate hazards may also result in long term risks. For example, wildfires may cause a loss of forest tress that increases the future risk of erosion and landslide events. The GWRC region must be prepared to confront multiple hazards concurrently.

Critical vs. Non-critical Hazards

Based on readily available data, local knowledge and observations, the steering committee performed a two-stage evaluation of above-mentioned hazards utilizing the Natural Hazard Ranking Sheet. First, they grouped the hazards into two categories; critical and non-critical hazards (see table).

- **Non-critical hazards**: those hazards resulting in slight to negligible property damages (less than 25% of critical and non-critical facilities and infrastructure); moderate to negligible quality of life lost; injuries or illnesses do not result in permanent disability and there are no deaths; and critical facilities are shut down for less than one week.
- **Critical hazards**: those hazards resulting in severe to moderate property damages (greater than 25% of critical and non-critical facilities and infrastructure); injuries or illnesses result in permanent disability and at least one death; and critical facilities are shut down for more than 1 week.

Secondly, the committee, in conjunction with the consulting team, ranked each critical hazard based on the probability of occurrence (see table). Hazards that ranked critical with a medium to high probability of occurrence were then investigated further and a vulnerability analysis was performed.

Probability of Occurrence

The probability of occurrence of a hazard event provides an estimation of how often the event occurs. This is generally based on the past hazard events that have occurred in the area and the forecast of the event occurring in the future. This is done by assigning a probability factor, which is based on yearly values of occurrence. The numerical value assigned to each category will be used to determine the risk rating of each hazard. These values were assigned by high, medium, and low occurrence:

- **High** – Frequent events with a well-documented history of occurrence.
- **Medium** – Occasional occurrences with at least two or more documented historic events.
- **Low** – Rare occurrences with at least one documented or anecdotal historic event.

4.3 - Community Specific Hazard Identification

This section presents the community-specific sections where those natural hazards that affect each member jurisdiction differently are discussed.

4.3.1 - Caroline County Hazard Identification (incl. Towns of Bowling Green and Port Royal)

For the 2017 plan update, the committee reviewed the Commonwealth of Virginia Hazard Mitigation Plan, as well as hazard events over the preceding five years, to determine the relative risk and priority (high, medium, or low) of various hazards as they specifically affect the locality. These hazards and their local priorities are presented in the chart below. For hazards that ranked high and medium-high were then investigated further and a specific vulnerability analysis was performed.

Hazard Priority –
Caroline County, Towns of Bowling Green and Port Royal

Identified Hazards	Local Hazard Priority
Dam Failure	Low
Drought and Extreme Heat	Medium
Wildfires	Medium-High
Earthquakes	Low
Sinkholes and Landslides	Low
Flooding and Erosion	Low
Non-Rotational Wind	Medium-High
Tornadoes	Medium-High
Winter Storms and Nor'easters	Medium-High

Wildfires

In evaluating the localized threat of wildfires to Caroline County (including the Towns of Bowling Green and Port Royal), the committee obtained fire occurrence data from the Virginia Department of Forestry. Fires occurring on federal lands were not included. These past occurrences are presented in the following table. Since 2009, 55 fires have burned 5189 acres of the County. However, this data is heavily influenced by a single fire in February of 2011 that burned 5006 acres alone. Total monetary damages from these wildfire events has totaled $5,137,400. Over this period, Caroline County has experienced an average of 6.9 wildfire events annually; therefore, the probability of future occurrences is ranked as high.

Flooding

In evaluating the localized threat of hurricanes to Caroline County (including the Towns of Bowling Green and Port Royal), the planning committee analyzed NOAA data to identify storms that may have posed a threat to the communities. The analysis included both floods and flash floods that impacted the region. These past occurrences are presented in the included table. Flooding has caused:

- Property and road damage;
- Displacement of individuals;
- Road closures;

Caroline is a county with low flood due to its resources and topography, with only nine flood events recorded since 1996, an average of 0.9 flood events per year, with most floods limited to temporary impacts on roadways with no lasting damage. The probability of future flood occurrences remains low.

Non-Rotational Wind (Hurricane and Thunderstorms)

In evaluating the localized threat of hurricanes to Caroline County (including the Towns of Bowling Green and Port Royal), the committee analyzed NOAA hurricane track data to identify storms that may have posed a threat to the communities. The analysis included hurricanes, tropical storms, tropical depressions, and extratropical storms, which passed through the region and the effects on the local community. These past occurrences are presented in the following table. Locally, the twelve (12) hurricanes have caused:

- Heavy rain;
- Gusty and high sustained winds;
- Flooding and property damage; and
- Power outages.

The probability of future occurrences is ranked as medium. With 12 hurricanes occurring between 1954 and 2016, Caroline County experiences approximately 0.21 hurricanes per year.

Tornadoes

In evaluating the localized threat of tornadoes to Caroline County (including the Towns of Bowling Green and Port Royal), the committee analyzed local emergency management data and NOAA severe weather data to identify storms that may have posed a threat to the community. These past occurrences are presented in the table. Locally, the ten (10) tornadoes recorded since 1975 have caused:

- Property damage, including the destruction of mobile homes;
- Tree damage and resultant power outages; and
- Loss of life.

The probability of future occurrences is ranked as medium. With 10 tornadoes occurring between 1975 and 2015, Caroline County experiences approximately 0.25 tornadoes per year.

Winter Storms and Nor'easters

Evaluating the localized threat of northeasters and winter storms to Caroline County (including the Towns of Bowling Green and Port Royal) was completed by the committee through analysis of local severe weather data from the NOAA to identify storms that may have posed a threat to the community. These past occurrences are presented in the table below. Locally, the 68 northeasters and winter storms have caused:

- Excessive snow, sleet, and freezing rain;
- Multiple traffic accidents and delays;
- Tree and property damage;
- Power outages; and
- Injury to human life.

The probability of future occurrences is ranked as medium. With 68 events occurring between 1993 and 2016, Caroline County experiences approximately three winter events annually.

Historic Wildfire Events – Caroline County, Towns of Bowling Green and Port Royal

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
8/18/2009	22	2,500	85,000	Miscellaneous
8/16/2009	0.5	500	5,000	Miscellaneous
8/12/2009	0.1	0	61,500	Debris Burning
10/9/2009	37	5,000	4,040,000	Smoking
3/7/2010	5	5,000	0	Miscellaneous
3/8/2010	8	4,500	12,500	Debris Burning
4/5/2010	1.5	2,500	150,000	Debris Burning
4/8/2010	9	8,000	2,000	Miscellaneous
4/15/2010	1	0	0	Miscellaneous
4/16/2010	0.1	0	0	Smoking
5/1/2010	1.5	500	0	Miscellaneous
6/11/2010	0.1	1,500	500	Miscellaneous
6/21/2010	10	0	101,500	Equipment Use
6/6/2010	0.1	100	209,000	Incendiary
6/8/2010	0.1	100	209,000	Incendiary
6/26/2010	0.1	100	209,000	Incendiary
7/5/2010	0.1	100	209,000	Incendiary
7/26/2010	0.5	200	0	Railroad
7/25/2010	0.1	0	0	Railroad
7/26/2010	0.5	0	85,000	Debris Burning
8/31/2010	0.1	100	0	Miscellaneous
9/24/2010	1	0	300,000	Miscellaneous
11/1/2010	1	500	0	Railroad

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
12/8/2010	0.1	0	0	Miscellaneous
2/16/2011	1.5	1,000	100,000	Equipment Use
2/17/2011	0.1	100	0	Equipment Use
2/19/2011	7	52,000	100,000	Miscellaneous
2/19/2011	1	500	110,000	Miscellaneous
2/16/2011	5006	5,006,000	3,050,000	Debris Burning
2/10/2011	42	35,000	2,180,000	Debris Burning
2/19/2011	0.1	0	25,000	Debris Burning
2/19/2011	6	5,500	340,000	Miscellaneous
2/25/2011	0.5	0	0	Miscellaneous
3/3/2011	0.1	0	0	Smoking
3/3/2011	2	0	0	Incendiary
3/3/2011	0.5	500	210,000	Incendiary
3/14/2011	0.1	100	0	Equipment Use
3/14/2011	0.1	0	0	Equipment Use
3/26/2011	0.1	0	130,000	Incendiary
4/6/2011	0.1	100	0	Smoking
4/14/2011	0.5	200	100,000	Railroad
4/14/2011	1.5	200	800,000	Railroad
2/8/2015	0.1	100	0	Smoking
3/13/2015	1	500	0	Railroad
4/6/2015	0.1	100	120,000	Debris Burning
4/22/2015	0.2	0	140,200	Miscellaneous
5/27/2015	0.1	0	0	Incendiary
2/29/2016	11.2	3,000	303,000	Debris Burning
2/29/2016	0.2	200	187,303	Debris Burning
3/10/2016	1	0	70,000	Debris Burning
3/24/2016	2	200	155,604	Miscellaneous
3/31/2016	2	500	252,000	Miscellaneous
4/26/2016	0.4	400	0	Railroad
11/17/2016	2	0	5,050,000	Debris Burning

Source: Virginia Department of Forestry, 2016

Historic Flooding Events – Caroline County. Towns of Bowling Green and Port Royal

Date	Event	Comments
January 19,1996	Urban/Stream Flood	Low lying areas of Caroline County roads experienced flooding from heavy rain and snow melt. Clogged storm drains further assisted this problem.

September 16, 1999	Flood	Caroline County received heavy rain from the remnants of Hurricane Floyd. Recorded rainfalls in the eastern portion of Caroline County exceeded 7 inches. Several roads in the region were washed out. The effects of Floyd were evident across the Commonwealth of Virginia and Maryland. The NCDC classified this as a 500-yr flood of record. Agriculture losses and property damages were reported at an estimated value of 122K.
July 28, 2000	Flash Flood	Heavy rains caused the flooding of secondary roads near Sparta in Caroline County.
March 20, 2003	Flood	Numerous roads closed across Caroline County and the surrounding areas due to high water. Roads closed included German School Road, Route 781, Route 615, Route 606, Route 644, Route 613, Route 658, Route 698, and Route 611.
June 26, 2006	Flash Flood	Heavy rains caused the closure of portions of Rte. 625 near Central Point in Caroline County.
June 28, 2006	Flash Flood	Heavy rains caused flash flooding and the closure of portions of Ladysmith Road near Bowling Green.
August 27, 2011	Flood	Heavy rains associated with Hurricane Irene produced widespread low-land flooding across much of the county, including roadways which were washed out or closed. Storm total rainfall generally ranged from three to seven inches. Bowling Green reported 3.76 inches of rain.
September 8, 2011	Flash Flood	Widespread flash flooding and numerous road closures across much of the county.
September 2, 2015	Flood	Flooding was reported on numerous county roads in the Ladysmith area. There were portions of Ladysmith Road closed.

Source: National Climatic Data Center, 2016.

Historic Hurricane Events – Caroline County, Towns of Bowling Green and Port Royal

Storm Name	Date	Category	Total Est. Damage	Descriptions
Hazel	October 15, 1954	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Connie	August 12, 1955	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Diane	August 17, 1955	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Camille	September 1960	Hurricane	Unknown	The Free-Lance Star reported massive flooding.
Floyd	September 16, 1999	Tropical Storm	No estimate available	Gusty winds from 30 to 50 mph 2 to 5 inches of rain 16,000 power outages
Isabel	September 18, 2003	Tropical Storm	$55.1M–property $130,000–crop	Highest sustained wind was73 mph Uprooted thousands of trees and downed numerous power lines Over 2 million Virginians without power
Charley And Bonnie	August 18, 2004	Hurricane	Unknown	Highest sustained wind was 73 mph Uprooted trees and downed numerous power lines Over 2 million Virginians without power Heavy rain and wind gust
Frances	September 8, 2004	Hurricane	Unknown	Generated 9 tornadoes in Central Virginia High winds Large amounts of rainfall/flooding
Ivan	September 17, 2004	Hurricane	Unknown	Spawned unconfirmed tornadoes Power outage (66,000) Heavy rain/flooding
Jeanne	September 28, 2004	Hurricane	Unknown	Flash flooding/heavy rainfall Power outage
Gaston	August 30, 2004	Tropical Depression	Unknown	Hard rains that processed flooding Roads under water Power outage (99,600 statewide)
Irene	August 27, 2011	Tropical Storm	$125 k	Tropical storm force winds knocked down several trees and power lines, as well as caused some structural damage. In addition, heavy rains contributed to minor crop damage. Storm total rainfall generally ranged from three to seven inches.

Source: NOAA 2004, VWC 2004, National Climate Data Center 2016, and local emergency management.

Historic Tornado Events – Caroline County. Towns of Bowling Green and Port Royal

Date	Magnitude	Property Damage ($)	Descriptions
March 24, 1975	F1	25K	NA
July 8, 1977	F0	25K	NA
August 12, 1977	F0	25K	NA
June 26, 1988	F0	0K	NA
April 1, 1998	F2	200K	Supercell thunderstorm produced a tornado along a 9 mile path extending from near Coatesville in northwest Hanover County eastward into south central Caroline County southeast of Ruther Glen. The damage path was nearly continuous along this track, with damage intensity ranging from F0/F1 to strong F2/F3. Damage path ranged from approximately 200 yards wide to near one quarter of a mile wide at its widest. Two mobile homes were destroyed in Caroline County. Several churches sustained damage, and several outbuildings were severely damaged or destroyed. One minor injury in Caroline County.
September 8, 2004	F1	25K	Town of Bowling Green - F1 tornado damaged or destroyed several buildings. Numerous trees downed or sheared. This tornado tracked into King George County.
September 17, 2004	F1	500K	F1 tornado downed numerous trees near Cosbys Corner. Many trees snapped off 10 feet above ground level. Cinderblock detached garage (30 x 32 foot) totally destroyed. Two vehicles damaged minor damage to home, and mobile home destroyed by falling tree. F1 tornado downed numerous trees on Friendship Road. Many trees snapped off 10 feet above ground level. One tree fell on a house and caused significant damage. Town of Port Royal - F1 tornado downed numerous trees near the intersection of Route 615 and Route 728 around Four Winds Golf Course. Many trees snapped off about 10 feet above ground level, and significant damage to 2 homes.
April 20, 2008	F0	15K	A supercell thunderstorm produced a tornado with F0 intensity 1 mile West South West of Sparta in Caroline County at around 15:45. The tornado destroyed the roof and exterior siding of a resident's garage blowing debris over a half-mile away. Top speeds of this tornado were estimated between 75 and 85 mph.
April 27, 2011	F1	15K	Scattered severe thunderstorms well in advance of a cold front produced damaging winds, large hail, and several tornadoes across portions of central Virginia. Tornado crossed Jericho Road, approximately 2.5 miles west of Carmel Church. Numerous trees were downed or sheared off.
June 20, 2015	F0	25K	A brief tornado touch down occurred less than one mile south of Bowling Green. Several trees were snapped off, and a couple of trees were downed. One large limb was downed on a mobile home. Additional large trees and power lines were downed in Fort A.P. Hill, along with significant damage to several large tents.

Source: National Climatic Data Center, 2016; Virginia Department of Emergency Management, 2016 NA = Data not available.

Historic Northeaster and Winter Storm Events – Caroline County. Towns of Bowling Green and Port Royal

Date	Event	Property Damage ($)	Comments
December 23, 1998	Ice Storm	20M	A major ice storm affected central and eastern Virginia from Wednesday, December 23rd into Friday, December 25th. A prolonged period of freezing rain and some sleet resulted in ice accumulations of one half inch /0.50/ to one inch /1.00/ in many locations. The heavy ice accumulations on trees and power lines caused widespread power outages across the region. Approximately 400,000 customers were without power during the maximum outage period, Christmas Eve day. Some customers were without power for about ten days. Many accidents occurred due to slippery road conditions, especially bridges and overpasses. Many secondary roads were impassable due to fallen tree limbs and in a few cases, whole trees.
January 8, 1999	Winter Weather	0	Sleet, freezing rain and freezing drizzle occurred off and on during Friday, January 8th across portions of the piedmont of central Virginia into the Virginia northern neck. This precipitation resulted in ice accumulations on many roads and bridges, and in turn, several accidents were reported.
January 15, 1999	Winter Weather	0	A strong arctic cold front moved slowly southeast across the Mid-Atlantic region from late on the 13th to midday on the 15th. By 9am on the 15th, ice accumulations from one quarter to nearly one inch occurred north of a line from Augusta County to Spotsylvania County. The ice this storm left behind had a large impact on the region. Hundreds of car accidents, slip and fall injuries, downed trees, and power outages were reported. In Stafford County, a jackknifed tractor trailer closed State Route 3 and 621, and Interstate 95 had to be temporarily shut down to clear fallen trees. Over 215,000 customers lost power from the storm across Northern Virginia, and Central Virginia reported over 6,000 additional outages.
March 9, 1999	Winter Storm	0	An area of low pressure moved from the Ohio Valley to North Carolina from late on the 8th through the evening of the 9th. Snowfall rates were in excess of 1 1/2 inches per hour in many locations during the storm. Stafford County received between 4 to 8 inches. Spotsylvania and King George County received between 2 and 6 inches. The City of Fredericksburg reported over 100 accidents. On Interstate 95 in Spotsylvania County, a woman was killed in a morning car accident. The combination of a weakening storm over the Ohio Valley, and a developing storm off the South Carolina coast produced 2 to 5 inches of snow across portions of the Virginia piedmont eastward into the Virginia northern neck Tuesday afternoon into early morning Wednesday. Beaverdam in Hanover County and Hague in Westmoreland County received 5 inches of snow. Ruther Glen in Caroline County and King and Queen in King and Queen County received 4 inches of snow.

Date	Event	Property Damage ($)	Comments
January 19, 2000	Winter Storm	0	An area of low pressure moved from west to east across the Mid-Atlantic region on the 20th, dropping 2 to 6 inches of snow between midnight and mid-afternoon. Gusty winds of 35 to 45 MPH developed during the afternoon causing the snow to drift across roadways and reduce visibilities in open areas. Two to three inches of snow fell overnight as an area of low pressure passed south of the region. The highest amounts were measured along a line from Caroline County in the north, through the city of Richmond, then along the southern shore of the James River to near the Newport News area. Snow briefly fell heavily after midnight, creating hazardous driving conditions.
January 25, 2000	Winter Storm	0	A significant winter storm dumped over one foot of snow across much of central and eastern Virginia, with isolated amounts of up to 19 inches reported. There was also significant blowing and drifting of snow as winds gusted over 30 mph during the storm. The Richmond International Airport was closed during this storm. A very cold air mass built into the region after the storm, preserving the snowpack for over a week in many areas. Snow drifts of 3 to 5 feet were reported, especially in the south central Virginia counties of Dinwiddie, Brunswick, and Mecklenburg. Specific county totals were: Mecklenburg county 13 to 16 inches, Lunenburg county 13 to 14 inches, Brunswick county 12 inches, Nottoway county 12 to 15 inches, Dinwiddie county including Petersburg city 14 to 18 inches, Prince George county including Hopewell 10 to 15 inches, Chesterfield county including Colonial Heights 9 to 15 inches, Charles City county 15 inches, Henrico county including Richmond city 10 to 12.5 inches, New Kent county 16 inches, Hanover county 9 to 12 inches, King William county 12 to 16 inches, King and Queen county 14 to 16 inches, Caroline County 12 inches, Essex county 16 to 17 inches, Richmond county 11 to 12 inches, Westmoreland county 12 to 13 inches, and Northumberland county 12 inches.
January 30, 2000	Ice Storm	465K	Cold air was in place east of the Blue Ridge Mountains on the 29th and 30th, keeping surface temperatures below freezing. Low pressure moved from the Lower Mississippi Valley northeastward to the Mid-Atlantic region early on the 30th, creating the perfect conditions for freezing rain around the Fredericksburg area, a mix of sleet and snow east of Skyline Drive, and moderate snowfall in the mountains. Ice accumulations between 1/4 and 3/4 of an inch coated roads, trees, and power lines in Fredericksburg and Stafford, Spotsylvania, and King George Counties. Electrical outages were reported as trees and branches weighed down by ice fell onto power lines. Disruptions affected 3000 customers in Fredericksburg and Spotsylvania and King George Counties. At one point, 300,000 people were without power in the Richmond vicinity due to the weight of ice downing trees and power lines. One Richmond TV station was knocked off the air for 45 minutes Two people were reported injured in Richmond; one while cutting downed trees with a chainsaw, another in a sledding accident.

Date	Event	Property Damage ($)	Comments
February 12, 2000	Winter Storm	0	A low pressure system tracked eastward from the Ohio valley and spread mainly light snow, sleet, and freezing rain across portions of central and eastern Virginia. Accumulations ranged from one to two inches, with one report of three inches of snow received from southern Louisa County. Warmer air moved in during the late afternoon and changed the precipitation over to rain.
February 22, 2001	Winter Storm	0	This system produced mainly light to moderate snowfall across the region between 9 AM and 10 PM. Snowfall amounts ranged from 2 to 5 inches. A 50 vehicle crash occurred on the northbound lanes near Masaponax in Spotsylvania County. The accident occurred as motorists crested the top of a hill, hit near zero visibility, and slammed on their breaks. Three people were treated for serious injuries and another 18 suffered minor injuries. The highway remained closed for three hours while the wreckage was cleared. A 30 vehicle pileup occurred on the southbound lanes just north of the Falmouth/Route 17 interchange in Stafford County. As whiteout conditions struck, three cars slid into each other. Within seconds, the minor fender bender turned into a pileup including tractor trailers, cars, trucks, and an empty bus. Three people were injured and the highway was blocked for nearly three hours.
January 2, 2002	Winter Storm	0	A winter storm produced 5 to 8 inches of snow across the piedmont of central Virginia, the Virginia northern neck, the middle peninsula, and the Virginia eastern shore. Some specific higher snow totals included: City of Richmond 7-8", City of Colonial Heights 8", Gloucester Point in Gloucester county 8", Mechanicsville in Hanover county 8", Nassawadox in Northampton county 8", Parksley in Accomack county 7", and Ruther Glen in Caroline County 7.5". Local law enforcement agencies reported numerous accidents. Most, if not all schools in the area, were closed Thursday, January 3rd and Friday, January 4th due to very slippery road conditions.
January 19, 2002	Winter Storm	0	Low pressure that moved across North Carolina on the 19th brought mixed precipitation to the region between 6 AM and 11 PM. In most locations, the precipitation started off in the form of snow, then changed to a mix of sleet and rain around midday. A winter storm produced a mixture of snow, sleet, and freezing rain across portions of central Virginia. Snowfall totals were 2 to 4 inches, except up to 5 inches occurred in parts of Fluvanna County. Local law enforcement agencies reported numerous accidents due to very slippery road conditions.

Date	Event	Property Damage ($)	Comments
December 4, 2002	Winter Storm	0	A winter storm produced 4 to 7 inches of snow along with less than 1/4 inch of ice across the piedmont of central Virginia and the Virginia northern neck. Some specific higher snow totals included: Louisa in Louisa county 7", Cumberland in Cumberland county 6", Goochland in Goochland county 5.5", Blackstone in Nottoway county 6", Ruther Glen in Caroline County 5", Farmville in Prince Edward county 5", Powhatan in Powhatan county 5.5", Palmyra in Fluvanna county 5", Amelia in Amelia county 5", Ashland in Hanover county 4.5", King William in King William county 5", Tappahannock in Essex county 5", and Montross in Westmoreland county 4". Local law enforcement agencies reported numerous accidents. Most, if not all schools in the area, were closed Thursday, December 5th and Friday, December 6th due to very slippery road conditions.
December 11, 2002	Winter Weather/mix	0	Freezing rain caused minor ice accumulations on trees, power lines, bridges and overpasses across portions of the central Virginia Piedmont. A few power outages and accidents were reported.
January 6, 2003	Winter Weather/mix	0	A weak winter storm produced only a dusting to 1 inch of snow across portions of central and eastern Virginia. Some specific snow totals included: City of Hampton 1", Eastern Newport News 1", City of Suffolk 1", City of Norfolk 0.5", Pembrooke area of Virginia Beach 0.5", Gloucester in Gloucester county 0.5", and Ruther Glen in Caroline County 0.5". Accumulations from this storm were mostly on cars and grassy areas, with roadways remaining generally wet although some slush was reported.
January 14, 2003	Winter Weather/mix	0	A weak winter storm produced one half (0.5) to one and one half (1.5) inches of snow across portions of the Virginia northern neck, middle peninsula, and Hampton Roads area. Some specific snow totals included: Kilmarnock in Lancaster county 1.5", Saluda in Middlesex county 1.5", King and Queen in King and Queen county 1-1.5", City of Newport News 1", City of Williamsburg 1", Ruther Glen in Caroline County 0.75", and Wallops Island in Accomack county 0.5".
January 16, 2003	Winter Storm	0	A winter storm produced 4 to 8 inches of snow across portions of central and eastern Virginia. Some specific higher snow totals included: Toano in James City county 8", Northern portion of York county 8", Gloucester in Gloucester county 7", Deltaville in Middlesex county 6.5", Mathews in Mathews county 6.5", Chincoteague in Accomack county 6", City of Newport News 6", Eastville in Northampton county 5.5", City of Hampton 5", City of Williamsburg 5", Surry in Surry county 5", West Point in King and Queen county 5", and Mangohick in King William county 5". Local law enforcement agencies reported numerous accidents. Most, if not all schools in the area, were closed Friday, January 17th due to very slippery road conditions.

Date	Event	Property Damage ($)	Comments
January 30, 2003	Winter Storm	0	A winter storm produced 3 to 5 inches of snow across portions of central Virginia. Some specific higher snow totals included: Crewe in Nottoway county 5", Farmville in Prince Edward county 4", Trenholm in Powhatan county 4", Gum Spring in Louisa county 4", Montpelier in Hanover county 4", Fife in Goochland county 4", Ashby in Cumberland county 4", and Ruther Glen in Caroline County 4". Local law enforcement agencies reported numerous accidents. Most, if not all schools in the area, were dismissed early on Thursday, January 30th due to very slippery road conditions.
February 6, 2003	Winter Storm	0	Low pressure tracked from the Gulf Coast to the Carolinas on the 6th then off the Atlantic coast on the 7th. This storm dropped light to moderate snow between the evening of the 6th and Noon on the 7th. Accumulations ranged from 3 to 7 inches. A winter storm produced 4 to 7 inches of snow across the piedmont of central Virginia and the Virginia northern neck. The higher snow amounts occurred in Caroline, Cumberland, Essex, Fluvanna, Goochland, Hanover, and Louisa counties. Local law enforcement agencies reported numerous accidents. Most, if not all schools in the area, were closed Friday, February 7th due to very slippery road conditions.
February 10, 2003	Winter Weather/mix	0	A weak winter storm produced 0.5 to 1 inch of snow across portions of the piedmont of central Virginia and the Virginia northern neck. Although, Louisa county reported 2 to 3 inches of snow. Accumulations from this storm were mostly on cars and grassy areas, with roadways remaining generally wet although some slush was reported.
February 15, 2003	Winter Storm	0	A complex storm system produced copious amounts of wintery precipitation across the northern third of Virginia between the evening of the 14th and midday on the 18th. After the precipitation came to an end, record breaking snow and sleet accumulations were reported. A winter storm produced 4 to 9 inches of snow, along with sleet and freezing rain, across central and eastern Virginia. Some specific higher snow totals included: Ruther Glen in Caroline County 9", Dunnsville in Essex county 8", Louisa in Louisa county 8", Newland in Richmond county 8", Heathsville in Northumberland county 7.5", Amelia in Amelia county 6.5", King William in King William county 6.5", Palmyra in Fluvanna county 6", Montross in Westmoreland county 6", Lancaster in Lancaster county 5.5", Northern Accomack county 5", Midlothian in Chesterfield county 5", Goochland in Goochland county 5", and Doswell in Hanover county 5". Local law enforcement agencies reported numerous accidents. Most, if not all schools in the area, were closed Monday, February 17th due to very slippery road conditions.

Date	Event	Property Damage ($)	Comments
February 26, 2003	Winter Storm	0	A series of low pressure systems that tracked from the Gulf Coast to Cape Hatteras dropped light snow off and on between the morning of the 26th and midday on the 28th. A total of 5 to 8 inches of snow accumulated across the northern third of Virginia during the storm. Minor traffic accidents were reported after the fallen snow made roads slippery. A winter storm produced 1 to 4 inches of snow, along with sleet and 1/8 to 1/2 inch of ice accumulation, across central and eastern Virginia. Some specific higher snow totals included: Ruther Glen in Caroline County 4.5", Bowling Green in Caroline County 3", West Point in King William county 3", Reedville in Northumberland county 3", Beaverdam in Hanover county 2.5", Louisa in Louisa county 2-3", and Montross in Westmoreland county 2-3". Local law enforcement agencies reported numerous accidents. Most, if not all schools in the area, were closed Thursday, February 27th due to very slippery road conditions.
December 14, 2003	Winter Storm	0	An area of low pressure developed over the Gulf Coast region and tracked northeast into the Mid Atlantic region. The storm produced a mixture of snow, sleet and freezing rain. Snowfall totals across Northeast Virginia averaged 3 to 4 inches. One to four inches of snow, and 1/4 to 1/2 inch of ice due to freezing rain, occurred across portions of central Virginia. The freezing rain on power lines resulted in scattered power outages, and roadways were very slippery.
January 25, 2004	Winter Storm	0	An area of low pressure developed off the coast of North Carolina and tracked north. This storm produced widespread snow, sleet and freezing drizzle over the region. Two to four inches of snow fell over the Central Foothills and the Northern Piedmont of Virginia. The snow mixed with sleet and finally changed over to freezing drizzle before tapering off. Several other minor accidents occurred according to Emergency Operations Centers. Dozens of school districts closed. Four to as much as six inches of snow and sleet fell across portions of central Virginia. Some higher amounts included: Farmville in Prince Edward county 6", Cumberland in Cumberland county 6", Montpelier in Hanover county 6", Columbia in Fluvanna county 5", Goochland in Goochland county 5", Glen Allen in Henrico county 5", and Tappahannock in Essex county 5". The snow and sleet produced very slippery roadways, which resulted in numerous accidents and school closings for a few days.
February 17, 2004	Winter Weather/mix	0	One half inch to two inches of snow fell across portions of central Virginia and the Virginia northern neck. The snow produced slippery roadways, which resulted in a few accidents.
December 19, 2004	Winter Weather/mix	0	One half inch to as much as three inches of snow fell across central and eastern Virginia. The snow produced slippery roadways, which resulted in several accidents. The highest amounts were reported at Lawrenceville in Brunswick county 3", Montross in Westmoreland county 3", South Hill in Mecklenburg county 2", and Sandston in Henrico county 2".
January 25, 2004	Winter Storm	0	Snow accumulation in Central Virginia reached as high as 6 inches. The snow and sleet produced very slippery roadways, which resulted in numerous accidents and school closings for a few days.

Date	Event	Property Damage ($)	Comments
February 17, 2004	Winter Weather/Mix	0	Snow accumulation of .5 to 2 inches occurred across portions of Central Virginia. The snow produced slippery roadways, resulting in a few accidents.
December 19, 2004	Winter Weather/Mix	0	Snow accumulation of .5 to 3 inches fell across Central and Eastern Virginia. The snow produced slippery roadways, resulting in several accidents.
January 19, 2005	Winter Weather/Mix	0	Snow accumulation of .5 to 2 inches occurred across portions of Central Virginia. The snow produced slippery roadways, resulting in a few accidents.
January 21, 2005	Winter Weather/Mix	0	Snow accumulation of .5 to 3 inches fell across Central and Eastern Virginia. The snow produced slippery roadways, resulting in several accidents
January 22, 2005	Winter Storm	0	Freezing rain produced .25 to .75 of an inch of ice across portions of Central Virginia. The freezing rain caused power outages, and roadways were very slippery resulting in numerous accidents.
January 29, 2005	Winter Storm	0	A mixture of freezing rain, sleet, and snow produced .25 to .5 of an inch of ice and 1 inch of snow across Central Virginia. The freezing rain on power lines caused outages, and roadways were slippery causing automobile accidents.
February 3, 2005	Winter Weather/Mix	0	Snow accumulation of .5 to 2 inches fell across the region. A few isolated areas reported close to 4 inches of snow. The snow produced slippery roadways, resulting in several accidents.
February 24, 2005	Winter Storm	0	Snow accumulation of 2 to 4 inches fell across Central Virginia. The snow produced slippery roadways, resulting in numerous accidents. Bowing Green in Caroline County reported 3.5 inches of snow.
February 28, 2005	Winter Weather/Mix	0	Snow accumulation of .5 to 2.5 inches of snow fell across Central Virginia. Ruther Glen in Caroline County reported 2 inches. The snow produced slippery roadways, resulting in several accidents.
December 5, 2005	Winter Storm	0	A winter storm produced 4 to 7 inches of snow and sleet across Central Virginia. Ruther Glen in Caroline County reported 4.5 inches of snow. The snow caused hazardous driving conditions, resulting in several reported accidents.
February 12, 2006	Winter Storm	0	A winter storm produced 4 to as much as 8 inches of snow across Caroline County. The highest amounts were reported in Corbin (8''), Bowling Green (6"), Ruther Glen (5"), and Burruss Corner (4.3"). The snow caused hazardous driving conditions, which resulted in numerous accidents.
April 7, 2007	Heavy Snow	0	Snow accumulation of 4 to 6 inches occurred in Central Virginia.

Date	Event	Property Damage ($)	Comments
March 1, 2009	Winter Storm	0	Snowfall amounts were between 6 and 11 inches across Caroline County. Several school closures were reported across the area.
January 30, 2010	Winter Storm	0	Snowfall amounts were between 8 and 12 inches across the county.
February 5, 2010	Winter Storm	0	Snowfall amounts were between 8 and 11 inches across Caroline County.
December 25, 2010	Winter Weather	0	Snowfall amounts were between 2 and 4 inches across Caroline County.
January 26, 2011	Winter Weather	0	Low pressure moving through the Mid-Atlantic region produced between one half inch and three inches of snow across portions of central and eastern Virginia from Wednesday afternoon into Wednesday night, January 26th. Snowfall amounts generally ranged between one half inch and two inches across the county. Bowling Green and Corbin reported 2.0 inches of snow.
February 19, 2012	Winter Weather	0	Low pressure moving off the North Carolina and South Carolina coasts produced between one and four inches of snow across portions of south central and eastern Virginia from Sunday evening, February 19th into early Monday morning, February 20th. Snowfall amounts were generally between two and four inches across the county. Ruther Glen reported 4.0 inches of snow. Milford reported 3.0 inches of snow.
March 5, 2012	Winter Storm	0	Low pressure moving across extreme southern Virginia and off the coast produced between three and six inches of snow across portions of central Virginia during Monday morning into early Monday afternoon, March 5th. Snowfall amounts were generally between three and six inches across the county. Ladysmith and Ruther Glen reported 5.5 inches of snow. Bowling Green reported 4.0 inches of snow.
January 17, 2013	Winter Weather	0	Low pressure moving off the North Carolina Coast produced between one and three inches of snow across portions of central and eastern Virginia from Thursday afternoon into Thursday night, January 17th. Snowfall amounts were generally between two and three inches across the county.
January 24, 2013	Winter Weather	0	Low pressure moving off the Mid Atlantic Coast produced between one and five inches of snow across portions of central and eastern Virginia Thursday morning, January 24th. The highest snow amounts occurred from the Virginia Northern Neck eastward into Accomack county of the Virginia Eastern Shore. Snowfall amounts were generally between one and two inches across the county. Ruther Glen reported 2.0 inches of snow.
March 6, 2013	Winter Storm	0	A coastal low pressure system produced widespread snowfall over central Virginia. Snowfall amounts were generally between three inches and six inches across the county. Bowling Green reported 3.8 inches, 4.0 inches, and 5.0 inches of snow. Ladysmith reported 5.0 inches of snow. Ruther Glen reported 8.0 inches of snow.
March 17, 2013	Winter Weather	0	A developing low pressure system brought light snowfall amounts to central and eastern Virginia. Snowfall amounts were generally between one inch and two inches across the county. Ruther Glen reported 1.5 inches of snow.

Date	Event	Property Damage ($)	Comments
March 24, 2013	Winter Weather	0	A developing low pressure system over the Southeast United States brought snow to central and eastern Virginia. Snowfall amounts were generally between two inches and four inches across the county. Ruther Glen reported 3.5 inches of snow.
December 8, 2013	Winter Weather	0	Cold high pressure over southern New England combined with low pressure moving northeast across the mid Atlantic region produced between one tenth of an inch and two tenths of an inch of ice from freezing rain. Freezing rain produced between 0.10 inch and 0.20 inch of ice accumulation. This resulted in slick roadways and scattered power outages.
January 2, 2014	Winter Weather	0	Low pressure intensifying off the Mid Atlantic Coast produced between one half inch and two inches of snow across portions of central and eastern Virginia. Snowfall amounts were generally between one half inch and one inch across the county. Ruther Glen reported 1.0 inch of snow.
January 10, 2014	Winter Weather	0	Light freezing drizzle developed along a stationary boundary over the northern Piedmont early in the morning. Law enforcement reported numerous accidents across the county due to a light glaze of ice on the roadways.
January 16, 2014	Winter Weather	0	Weak low pressure developing along a cold front pushed through the East Coast during the morning of Thursday January 16, producing snowfall amounts of less than 2.0 inches across portions of central, south central and eastern Virginia. Snowfall of 0.5 inch was reported in Ruther Glen.
January 21, 2014	Winter Weather	0	Coastal low pressure intensifying off the Mid Atlantic Coast produced a widespread two to five inches of snowfall from the Virginia Piedmont to the Virginia Eastern Shore. Snowfall amounts were generally between one inch and three inches across the county. Bowling Green reported 3.0 inches of snowfall and Ruther Glen reported 2.5 inches of snowfall.
January 28, 2014	Winter Weather	0	Coastal low pressure intensifying off the Mid Atlantic Coast produced widespread snowfall ranging from two to ten inches of snowfall from the Virginia Piedmont to the Virginia Eastern Shore. Highest snowfall amounts were over southeast Virginia. Snowfall amounts were generally between two inches and four inches across the county. Ruther Glen reported 4.0 inches of snowfall and Milford reported 3.5 inches of snowfall.
February 12, 2014	Winter Storm	0	Intensifying low pressure moving northward along the coast produced between four and ten inches of snow across portions of central and eastern Virginia from Wednesday afternoon, February 12th into Thursday evening, February 13th. Snowfall amounts were generally between four inches and eight inches across the county. Ladysmith reported 8.0 inches of snow. Ruther Glen reported 7.0 inches of snow. Bowling Green reported 6.0 inches of snow.
March 3, 2014	Winter Storm	0	Low pressure intensified along a cold front as it dropped over the Mid-Atlantic region. The result was widespread snowfall across Virginia with snowfall amounts reaching five to seven inches. Snowfall amounts were generally between three inches and six inches across the county. Bowling Green reported 5.5 inches of snowfall and Ladysmith reported 4.5 inches of snowfall.

Date	Event	Property Damage ($)	Comments
March 16, 2014	Winter Storm	0	A complex area of low pressure developed along a stalled cold front across the Southeast United States with weak high pressure over New York, creating a mixed batch of snow and sleet across the northern sections of the Wakefield County Warning Area. Snowfall of 5.0 inches was reported in Port Royal and 3.0 inches was reported in Ruther Glen.
January 26, 2015	Winter Weather	0	Colder air combined with an upper level disturbance on the back side of strong low pressure off the southern New England coast produced one half inch to two inches of snow across portions of central and eastern Virginia. Snowfall amounts were generally between 0.5 inch and 1.0 inch across the county. Ruther Glen reported 0.5 inch of snow.
February 16, 2015	Winter Storm	0	Low pressure moving from the Southern Plains east northeast and off the Mid Atlantic Coast produced between four inches and nine inches of snow across central, south central and eastern Virginia from Monday afternoon, February 16th through early Tuesday morning, February 17th. Snowfall amounts were generally between four inches and seven inches across the county.
February 21, 2015	Winter Weather	0	Low pressure tracking from the Southern Plains northeast through Kentucky and Tennessee produced a mixture of snow, sleet and freezing rain across portions of central Virginia during Saturday, February 21st. The storm produced between one half inch and three inches of snow, and a trace to two tenths of an inch of ice. Snowfall amounts generally ranged between one half inch and one inch, and ice amounts ranged from a trace to one tenth of an inch.
February 26, 2015	Winter Storm	0	Intensifying low pressure tracking from the Gulf of Mexico northeast and off the southeast and mid Atlantic coast produced between four inches and nine inches of snow across central and south central Virginia from late Wednesday night, February 25th through Thursday morning, February 26th. Snowfall amounts were generally between four inches and seven inches across the county. Bowling Green reported 6.5 inches of snow. Ruther Glen reported 6.0 inches of snow.
March 1, 2015	Winter Weather	0	Low pressure moving northeast from the Tennessee Valley into southwest Virginia produced freezing rain and freezing drizzle across portions of south central and central Virginia, and the Virginia Northern Neck. Ice accumulations ranged from a trace to 0.12 inch. Ice accumulations ranged from a trace to .10 inch. Ruther Glen reported .10 inch of ice.
March 5, 2015	Winter Storm	0	Low pressure moving from the Tennessee Valley eastward and off the Mid Atlantic Coast produced between three inches and seven inches of snow across portions of central Virginia and the Virginia Northern Neck during Thursday, March 5th. Snowfall amounts were generally between three inches and six inches across the county. Bowling Green reported 5.8 inches of snow.
January 22, 2016	Winter Storm	0	Strong Low Pressure moving from the Southeast United States northeast and off the Mid Atlantic Coast produced between eight and nineteen inches of snow and strong winds across central Virginia. Snowfall totals were generally between 10 inches and 18 inches across the county. Claiborne reported 18.0 inches of snow. Ruther Glen reported 17.5 inches of snow. Penola reported 16.0 inches of snow. Milford reported 14.5 inches of snow.

Date	Event	Property Damage ($)	Comments
February 14, 2016	Winter Storm	0	The combination of Cold High Pressure moving off the Mid Atlantic Coast and Low Pressure tracking from eastern Texas northeast toward the Mid Atlantic Coast produced between three and six inches of snow across the Virginia Northern Neck and Central Virginia Piedmont. Snowfall totals were generally between 3 inches and 6 inches across the county. Carters Corner reported 5.5 inches of snow. Milford (5 S) reported 4.0 inches of snow. Bowling Green reported 3.5 inches of snow. Freezing rain and freezing drizzle produced one tenth of an inch of ice.
March 3, 2016	Winter Weather	0	Low pressure tracking from the Tennessee valley eastward and off the North Carolina coast produced between one and three inches of snow across portions of the Virginia Northern Neck, Middle Peninsula, and Virginia Eastern Shore. Snowfall totals were generally between 1 inch and 3 inches across the county.

Source: National Climatic Data Center, 2016.

4.3.2 - City of Fredericksburg Hazard Identification

For the 2017 plan update, the committee reviewed the Commonwealth of Virginia Hazard Mitigation Plan, as well as hazard events over the preceding five years, to determine the relative risk and priority (high, medium, or low) of various hazards as they specifically affect the locality. These hazards and their local priorities are presented in the chart below. For hazards that ranked high and medium-high were then investigated further and a specific vulnerability analysis was performed.

Hazard Priority – City of Fredericksburg

Identified Hazards	Local Hazard Priority
Dam Failure	N/A
Drought and Extreme Heat	Medium-High
Wildfires	Medium-High
Earthquakes	Medium
Sinkholes and Landslides	Medium-Low
Flooding and Erosion	High
Non-Rotational Wind	High
Tornadoes	High
Winter Storms and Nor'easters	High

Flooding

Flooding is one of the most significant natural hazards faced by the City of Fredericksburg. The primary source of floodwaters affecting the City is riverine flooding from the Rappahannock River that occurs in conjunction with heavy rains from hurricanes, tropical storms and northeasters. Urban and flash flooding also affects the City. Flooding can occur during any season of the year. Listed in the table are the significant flood events for the City of Fredericksburg. Areas located with the 100-year flood boundary as delineated on the FEMA FIRM are at risk of flooding. Low-lying areas that border streams and creeks are particularly at risk. Any areas where waters can pond due to obstruction to the stormwater system are also susceptible to flooding.

The probability of future occurrences is ranked as high. A 100-year event has a one percent probability of occurring in any given year. The 100-year floodplains for the City of Fredericksburg have been identified.

Non-Rotational Wind (Hurricanes and Thunderstorms)

In evaluating the localized threat of hurricanes to the City of Fredericksburg, the committee analyzed NOAA hurricane track data to identify storms that may have posed a threat to the community. The analysis included hurricanes, tropical storms, tropical depressions, and extratropical storms which passed

through the region and the affected the local community. These past occurrences are presented in the following table. Locally, the eleven (11) hurricanes have caused:

- Heavy rain;
- Gusty and high sustained winds;
- Flooding and property damage; and
- Multiple power outages.

The probability of future occurrences is ranked as medium. With 11 hurricanes occurring between 1954 and 2016, the City of Fredericksburg experiences approximately 0.22 hurricanes per year.

Tornadoes

In evaluating the localized threat of tornadoes to the City of Fredericksburg, the committee analyzed local emergency management data and NOAA severe weather data to identify storms that may have posed a threat to the community. Three tornado events are recorded as crossing into the City limits. These past occurrences are presented in the following table. Locally, the three (3) tornadoes have caused:

- Excessive winds and lightning;
- Large hail; and
- Tree and property damage.

The probability of future occurrences is ranked as medium. With three tornadoes occurring between 1999 and 20016, the City of Fredericksburg experiences approximately 0.2 tornadoes per year.

Winter Storms

In evaluating the localized threat of northeasters and winter storms to the City of Fredericksburg, the committee analyzed local NOAA severe weather data to identify storms that may have posed a threat to the community. These past occurrences are presented in the included table.

Locally northeasters and winter storms have caused:

- Excessive snow, sleet, and freezing rain;
- Multiple traffic accidents and delays;
- Tree and property damage;
- Power outages; and
- Injury and loss of life.

The probability of future occurrences is ranked as medium, with the City of Fredericksburg experiencing greater than 2 winter events per year.

Historic Flood Events – City of Fredericksburg

Date	Event	Comments
September 3, 2000	Flash Flood	The City of Fredericksburg was hit especially hard by flash flooding after a total of 2.24 inches of rain fell. Several residents of homes and ground floor apartments reported damaged from rapidly rising water that entered the structures through sewer systems, basement windows, and doors. Several motorists had to be rescued from their cars after driving into flooded sections of roadway. Some cars were submerged up to their windshields in water. High water blocked access to Mary Washington Hospital. A 4-foot-deep sinkhole appeared along Snowden Hills Boulevard after the deluge.
July 10, 2003	Flash Flood	In Fredericksburg, an apartment building was struck by lightning. Also, two homes in Normandy Village on Woodford Street caught fire after being hit by lightning. Lightning also damaged asphalt on William Street at Sunken Road. Cowan Boulevard was closed by flooding.
July 13, 2005	Flash Flood	In Fredericksburg, reports of flooding occurred in the early evening. Fall Hill Avenue closed due to high water. There were reports of additional flooding on roads leading to Mary Washington Hospital. Several cars stalled at the hospital entrance.
August 25-26, 2006	Flash Flood	Persistent rain across a 5 day period resulted in double digit rainfall totals across Northern Virginia. There were extensive power outages across the region and the VRE was temporarily inoperable. In Fredericksburg, the Rappahannock River was out of its banks at the Falmouth Bridge on U.S. 1. At Alum Springs Park a woman and her children stalled their pickup truck. Total estimates of property damage were 10K.
December 7, 2011	Flood	A cold front stalled across southern Virginia and along the Mid-Atlantic seaboard. Several weak low pressure systems moved along the boundary, with an intense low pressure passing along it on the afternoon of the 7th. An extended period of moderate to heavy rain resulted across much of northern Virginia. Rainfall amounts reached as high as 4.32 in Spotsylvania County. High water was reported on River Road near Bragg Road. A rain gauge near Brookfield reported 4.02 inches.
July 14, 2012	Flash Flood	A slow moving warm front was located across central Virginia. During the afternoon, showers and thunderstorms developed along and north of this feature. A very warm and moist atmosphere along with light winds throughout the atmosphere caused very high rainfall rates with slow storm motion. Flash flooding resulted. Flash flooding forced the closure of the 200 block of Wilderness Lane, 800 block of Dixon Street, 900 block of Blue Grey Parkway and the 200 block of Howison Avenue.

Source: NOAA 2016

Historic Hurricane Events – City of Fredericksburg

Storm Name	Date	Category	Total Est. Damage	Descriptions
Hazel	October 15, 1954	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Connie	August 12, 1955	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Diane	August 17, 1955	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Camille	September 1960	Hurricane	Unknown	The Free-Lance Star reported massive flooding.
Floyd	September 16, 1999	Tropical Storm	No estimate available.	Gusty winds from 30 to 50 mph 2 to 5 inches of rain 16,000 power outages
Isabel	September 18, 2003	Tropical Storm	$55.1 million – property $130,000 – crop	Highest sustained wind was73 mph Uprooted thousands of trees and downed numerous power lines Over 2 million Virginians without power
Charley And Bonnie	August 18, 2004	Hurricane	Unknown	Highest sustained wind was 73 mph Uprooted trees and downed numerous power lines Over 2 million Virginians without power Heavy rain and wind gust
Frances	September 8, 2004	Hurricane	Unknown	Generated 9 tornadoes in Central Virginia High winds Large amounts of rainfall/flooding
Ivan	September 17, 2004	Hurricane	Unknown	Spawned unconfirmed tornadoes Power outage (66,000) Heavy rain/flooding
Jeanne	September 28, 2004	Hurricane	Unknown	Flash flooding/heavy rainfall Power outage
Gaston	August 30, 2004	Tropical Depression	Unknown	Hard rains that processed flooding Roads under water Power outage (99,600 statewide)

Source: NOAA 2004, VWC 2004, and local emergency management.

Historic Tornado Events – City of Fredericksburg

Date	Magnitude	Property Damage ($)	Descriptions
July 24, 1999	F1	20K	Spotsylvania County tornado crossed over the City of Fredericksburg Warm and humid air ahead of a cold front combined to produce scattered thunderstorms across the northern half of Virginia from midday through sunset. The first batch of thunderstorms developed over Rockingham County around 12:30 PM EDT and moved eastward to the Potomac River by 3:00 PM EDT. These storms produced winds in excess of 55 MPH, large hail, frequent lightning, and a tornado that crossed parts of Orange, Spotsylvania, and Stafford County. A tornado developed near Lake of the Woods in Orange County. It stayed on the ground for 20 miles and moved across northern Spotsylvania County, the city of Fredericksburg, and the northwest portion of Stafford County. The tornado was of F1 strength for most of its path, occasionally weakening to F0 strength in some locations. Next, the storm passed directly over the southern half of the city of Fredericksburg, downing several more trees and power lines, blocking roads and knocking power out for 12,000 customers. Nine buildings in the city were significantly damaged.
May 7, 2004	F1	10K	At 7:51 p.m., an F1 tornado touched down near Shiloh. At least a dozen dwellings and 10 boats were damaged. Several trees were also uprooted or had their tops ripped out along the storm's three-mile path. In Stafford County, 80 to 90 mph winds destroyed two homes and caused major damage to 20 others. The Japazawas Subdivision in eastern Stafford County had approximately 40 trees down. Three Amtrak trains were stalled between the Chatham area of Stafford and Fredericksburg due to downed trees and power lines. In Spotsylvania County, the main stage at the re-enactment of the Battle of Spotsylvania collapsed due to strong winds. A number of tents and a couple of portable toilets were also blown over. Estimated damages were $10,000.
September 17, 2004	F1	0K	A thunderstorm moved from Spotsylvania County into the eastern portion of the City of Fredericksburg. No property damage was reported, with debris scattered along Dixon Street.

Source: National Climatic Data Center, 2005; NOAA 2004 and VDEM

Historic Northeaster and Winter Storm Events – City of Fredericksburg

Date	Event	Rain Fall (in.)	Comments
January 20, 2000	Winter Weather	0	An area of low pressure moved from west to east across the Mid-Atlantic region on the 20th, dropping 2 to 6 inches of snow between midnight and mid-afternoon. Gusty winds of 35 to 45 MPH developed during the afternoon causing the snow to drift across roadways and reduce visibilities in open areas.

Date	Event	Rain Fall (in.)	Comments
January 25, 2000	Northeaster	0	Low pressure off Cape Hatteras rapidly intensified late on the 24th and developed into a nor'easter which tracked northward along the Eastern Seaboard on the 25th. Very heavy snow and near-blizzard conditions were seen throughout the day east of the Blue Ridge Mountains, resulting in extremely hazardous travel conditions. Wind gusts of up to 45 MPH were recorded and several roads were drifted shut by blowing snow. The governor of Virginia declared a state of emergency as the storm battered the eastern part of the state.
January 30, 2000	Ice Storm	0	Cold air was in place east of the Blue Ridge Mountains on the 29th and 30th, keeping surface temperatures below freezing. Low pressure moved from the Lower Mississippi Valley northeastward to the Mid-Atlantic region early on the 30th, creating the perfect conditions for freezing rain around the Fredericksburg area, a mix of sleet and snow east of Skyline Drive, and moderate snowfall in the mountains. Ice accumulations between 1/4 and 3/4 of an inch coated roads, trees, and power lines in Fredericksburg and Stafford, Spotsylvania, and King George Counties. Electrical outages were reported as trees and branches weighed down by ice fell onto power lines. Disruptions affected 3000 customers in Fredericksburg and Spotsylvania and King George Counties.
February 12, 2000	Winter Weather	0	Low pressure moved from Tennessee to the North Carolina Coast on the 12th, spreading snow across the Central Shenandoah Valley and the Northern and Central Piedmont. Periods of light snow occurred from sunrise to late afternoon with accumulations ranging from 1 to 5 inches. A period of freezing drizzle also occurred around sunset.
December 13, 2000	Winter Weather	0	A strong cold front brought chilly air into the region on the 12th. By the afternoon of the 13th, an upper level disturbance brought warm air into the mid levels of the atmosphere and caused snow that fell from the system to melt to rain on its way down. When the rain hit the ground where temperatures were below freezing, ice accumulated.
February 22, 2001	Winter Storm	0	This system produced mainly light to moderate snowfall across the region between 9 AM and 10 PM. Snowfall amounts ranged from 2 to 5 inches. A 50 vehicle crash occurred on the northbound lanes near Masaponax in Spotsylvania County. The accident occurred as motorists crested the top of a hill, hit near zero visibility, and slammed on their breaks. Three people were treated for serious injuries and another 18 suffered minor injuries. The highway remained closed for three hours while the wreckage was cleared. A 30 vehicle pileup occurred on the southbound lanes just north of the Falmouth/Route 17 interchange in Stafford County. As whiteout conditions struck, three cars slid into each other. Within seconds, the minor fender bender turned into a pileup including tractor trailers, cars, trucks, and an empty bus. Three people were injured and the highway was blocked for nearly three hours.
January 3, 2002	Winter Storm	0	Low pressure tracked across extreme southeast Virginia during the morning of the 3rd. This storm brought light to moderate snowfall to the Central Piedmont and Fredericksburg areas between 5 AM and 3 PM. In Stafford County, an inch of snow caused slippery roads and delayed school openings. In Spotsylvania and King George Counties, snowfall totals ranged from 3 to 5 inches.

Date	Event	Rain Fall (in.)	Comments
January 19, 2002	Winter Weather	0	Low pressure that moved across North Carolina on the 19th brought mixed precipitation to the region between 6 AM and 11 PM. In most locations, the precipitation started off in the form of snow, then changed to a mix of sleet and rain around midday.
December 5, 2002	Winter Storm	0	This storm produced accumulating snowfall across the entire region as it moved by. Across the Central Piedmont and Fredericksburg area, freezing rain and sleet was mixed in with the snow. The snow and sleet accumulations ranged from 4 to 6 inches in this area.
February 6, 2003	Winter Storm	0	Low pressure tracked from the Gulf Coast to the Carolinas on the 6th then off the Atlantic coast on the 7th. This storm dropped light to moderate snow between the evening of the 6th and Noon on the 7th. Accumulations ranged from 3 to 7 inches.
February 14, 2003	Winter Storm	8.9M	A complex storm system produced copious amounts of wintery precipitation across the northern third of Virginia between the evening of the 14th and midday on the 18th. After the precipitation came to an end, record breaking snow and sleet accumulations were reported.
February 26, 2003	Winter Weather/mix	0	A series of low pressure systems that tracked from the Gulf Coast to Cape Hatteras dropped light snow off and on between the morning of the 26th and midday on the 28th. A total of 5 to 8 inches of snow accumulated across the northern third of Virginia during the storm. Minor traffic accidents were reported after the fallen snow made roads slippery.
December 14, 2003	Winter Weather/mix	0	An area of low pressure developed over the Gulf Coast region and tracked northeast into the Mid Atlantic region. The storm produced a mixture of snow, sleet and freezing rain. Snowfall totals across Northeast Virginia averaged 3 to 4 inches.
January 25, 2004	Winter Weather/mix	0	An area of low pressure developed off the coast of North Carolina and tracked north. This storm produced widespread snow, sleet and freezing drizzle over the region. Two to four inches of snow fell over the Central Foothills and the Northern Piedmont of Virginia. The snow mixed with sleet and finally changed over to freezing drizzle before tapering off. Several other minor accidents occurred according to Emergency Operations Centers. Dozens of school districts closed.
January 30, 2005	Winter Storm	0	A storm system brought a mix of snow, sleet, and freezing rain affecting most of Central Virginia. Freezing rain accumulated to around .25 inches resulting in hazardous driving conditions.
December 5, 2005	Heavy Snow	40K	A winter weather storm produced 4 to 6.5 inches of snow across Northern Virginia. There were reports of trees down in Spotsylvania County due to heavy snow accumulations.
February 11, 2006	Heavy Snow	250K	Storm snowfall across Northern Virginia produced between 8 and 14 inches. There were reports of isolated drifting of snow and downed powerlines throughout the region. This caused over 300,000 customers to be without power in the greater Washington/Baltimore area.
March 1, 2009	Winter Storm	0	A low pressure system produced storms releasing averaged snowfall totals of 5 inches across Spotsylvania County and the rest of Northern Virginia.

Date	Event	Rain Fall (in.)	Comments
January 30, 2010	Winter Storm	0	Snowfall amounts between 5 and 6 inches were reported across Spotsylvania County.
February 16, 2010	Winter Storm	0	Snowfall totaled up to 1.5 inches in Chancellorsville in Spotsylvania County. There were several reports of accidents during rush hour near Fredericksburg and Chancellorsville.
December 16, 2010	Winter Storm	0	Snowfall was estimated around 4 inches in Spotsylvania County.
January 20, 2012	Winter Weather	0	Low pressure passed through the area during the evening of the 20th into the morning hours of the 21st. There was enough cold air for precipitation to start off as snow, but warmer air eventually wrapped into the system, causing precipitation to change to a wintry mix. Snow and sleet accumulations were estimated to be around an inch or less across the county. A glaze of ice accumulation from freezing rain was also estimated.
January 22, 2012	Winter Weather	0	Low pressure was located over the central portion of the nation while high pressure remained just off the New England Coast. Surface cold air remained in place during the evening hours of the 22nd into the morning hours of the 23rd. A southerly flow around the low allowed for warm and moist air to overrun the surface cold air, resulting in periods of freezing drizzle. Temperatures rose above freezing later during the morning hours of the 23rd.A light glaze of ice was estimated across the county.
February 19, 2012	Winter Weather	0	Low pressure passed by to the south while high pressure to north pumped in cold air. Precipitation associated with the low fell in the form of snow across central Virginia. Snowfall totaled up to 1.8 inches about three miles east of Dunavant.
March 5, 2012	Winter Storm	0	A potent area of low pressure tracked through southern Virginia during the morning and early afternoon hours of the 5th. A band of precipitation developed on the northern side of the low. There was enough cold air for precipitation to fall in the form of snow, and the heaviest snow was across central Virginia. Snowfall totaled up to 5.0 inches at the Spotsylvania Courthouse.
January 23, 2013	Winter Weather	0	A positively tilted trough of low pressure moved through the Mid Atlantic while a weak clipper system moved through Central Virginia. Cold temperatures and banding produced advisory level snowfall accumulations. Snowfall amounts of around an inch were reported during the morning rush hour.
January 25, 2013	Winter Weather	0	An Alberta clipper moved through the Mid Atlantic producing light snow for most of the region. Dry air at the surface limited snowfall amounts for most of the area. Snowfall amounts of around one inch was reported at surrounding locations during the evening rush hour.
February 1, 2013	Winter Weather	0	A clipper system moved through the Mid Atlantic in the early morning hours and produced advisory level snowfall in the Baltimore and Washington DC metro areas. Snowfall amounts of around an inch were reported at surrounding locations during the morning rush hour.
March 5, 2013	Winter Storm	0	Strong low pressure impacted the Mid Atlantic bringing rain and snow to the region. A rain-snow line was present across the I-95 corridor where snowfall accumulations dropped off significantly from west to east. Snowfall amounts of 8 inches were reported at Dunavant.

Date	Event	Rain Fall (in.)	Comments
March 17, 2013	Winter Weather	0	Low pressure developed along a stationary front south of the Washington DC. Surface temperatures were marginal and snowfall accumulated west of the I-95 corridor. A cold air damming situation formed during the event and led to accumulating snow across the Shenandoah Valley and Central Foothills. Snowfall totaled up to around one inch near White Oak and Spotsylvania.
March 24, 2013	Winter Weather	0	Coastal low pressure impacted the Mid-Atlantic region with snow and rain showers. Surface temperatures were marginal during the event and a sharp gradient of snowfall accumulation existed near Washington DC. Snowfall totaled up to 4.2 inches about ten miles west of Fredericksburg.
December 8, 2013	Winter Weather	0	Ice accumulations of around a tenth of an inch fell at surrounding locations.
January 2, 2014	Winter Weather	0	Low pressure tracked across the Mid Atlantic and led to accumulating snow with the highest amounts from Northern Virginia to East-Central Maryland. Low pressure quickly moved off the coast. Snow accumulations of two inches or more were measured at surrounding locations.
January 10, 2014	Winter Weather	0	A weak disturbance crossed the Mid Atlantic while a wedge of high pressure was at the surface. Precipitation that fell melted aloft and froze on contact. Ice accumulations of a trace or more were measured at surrounding locations.
January 21, 2014	Winter Weather	0	A shortwave trough moved into the region while low pressure developed south of the Mid Atlantic. Upper level dynamics led to moderate to heavy snow to move into the region. Snow accumulations of two inches or more were measured at surrounding locations.
January 28, 2014	Winter Weather	0	Snow accumulations of two inches were measured at surrounding locations.
February 4, 2014	Winter Weather	0	Ice accumulation of a trace or more was reported at surrounding locations.
February 12, 2014	Winter Storm	0	Low pressure moved up the east coast and approached the Mid Atlantic. High pressure was located across New England and fed cold air into the region. Heavy snow fell across most parts of the Mid Atlantic with the highest amounts near the Mason Dixon line where mid level forcing led to a heavy band. Snow accumulations of 6 or more inches were measured at White Oak.
March 3, 2014	Winter Storm	0	A cold front crossed the region as low pressure passed across the south of the Mid Atlantic and heavy snow moved across the region. Temperatures dropped from north to south and precipitation changed from rain to sleet/freezing rain to snow. Snow accumulations of five or more inches was measured at Spotsylvania.
March 7, 2014	Winter Weather	0	Ice accumulation of a trace was reported at Spotsylvania.
March 16, 2014	Winter Storm	0	Two areas of low pressure formed south of the Mid Atlantic. Dry and cold air at the surface led to precipitation to quickly change to snow. Heavy snow fell across the region with a confined area of greater than 10 inches across the Central Foothills. Snow accumulation of five or more inches was measured at Fredericksburg.
March 18, 2014	Winter Weather	0	A wedge of high pressure was across the Mid Atlantic. Low level moisture and sub freezing temperatures led to freezing drizzle and freezing rain across the Central Foothills, Shenandoah Valley, Piedmont and Southern Maryland. Ice accumulation of a trace was reported at surrounding locations.

Date	Event	Rain Fall (in.)	Comments
March 25, 2014	Winter Weather	0	Snow accumulation of 2 inches or more was measured at surrounding locations.
February 16, 2015	Winter Storm	0	A surface low formed over Texas, then quickly moved east during the day and overnight, pushing off the Carolina coast by the morning of the 17th. A very cold airmass in place from retreating Arctic high pressure resulted in higher than average snow ratios, between 12:1 and 15:1. Central Virginia received the highest amounts, with lower amounts to the north and west. Between 5.0 and 8.5 inches was reported by multiple sources in the county and surrounding areas.
February 21, 2015	Winter Weather	0	Low pressure lifting from the Ohio River Valley into the eastern Great Lakes dragged a cold front through the region. Southerly flow ahead of the front resulted in high moisture advection and with temperatures hovering in the 20s, moderate to heavy snow was reported across the region. Snow totals between 2.0 and 3.0 inches was reported. Ice totals between a trace and 0.05 inches was reported.
February 25, 2015	Winter Weather	0	Low pressure passing to the south brought widespread snow. Between 2-2.5 inches reported.
March 1, 2015	Winter Weather	0	Storm total ice between 0.10 and 0.20 inches was reported around the county.
March 5, 2015	Winter Storm	0	A cold front brought widespread heavy snow to the area with a strong convergence zone aligning across northern Virginia into eastern Maryland resulting in mesoscale banding and higher snow totals. Storm total snow between 5.0 and 7.0 inches was reported around the county and in surrounding areas.
January 20, 2016	Winter Weather	0	A shortwave trough swung through the Mid-Atlantic during the later afternoon and evening hours. A quick burst of snow occurred during the peak of rush hour and with below freezing temperatures already place, led to accumulations of up to one inch. Hundreds of traffic incidents were reported with icy conditions forming on the roadways. Spotters reported around half of an inch across the county.
January 22, 2016	Winter Storm	0	Coastal low pressure rapidly intensified as it tracked up the Mid-Atlantic coast. At the same time, high pressure to the north was funneling cold air into the region. The strong low pressure system was able to tap into moisture from the Gulf of Mexico and the Atlantic Ocean resulting in heavy amounts of precipitation. The cold air caused that precipitation to fall in the form of snow. Gusty winds also accompanied this storm. The combination of gusty winds and low visibility along with snow and blowing snow caused blizzard conditions across portions of northern Virginia. Snowfall amounts between 17 and 24 inches were reported across Spotsylvania County.
February 14, 2016	Winter Storm	0	Prolonged event impacted the Mid-Atlantic. Southwest flow aloft overriding northeast flow at the surface from departing high pressure led to snow spreading over the region initially. Low pressure formed and organized over the Gulf of Mexico, eventually pushing off to the northeast and impacting the region on the 15th. As the cold air wedge was eroded away from this low, warming at all levels led to the snow transitioning to sleet and ice for most of the area. Between 5 and 8 inches of snow was reported.

Source: National Climatic Data Center, 2016.

4.2.3 - King George County Hazard Identification

For the 2017 plan update, the committee reviewed the Commonwealth of Virginia Hazard Mitigation Plan, as well as hazard events over the preceding five years, to determine the relative risk and priority (high, medium, or low) of various hazards as they specifically affect the locality. These hazards and their local priorities are presented in the chart below. For hazards that ranked high and medium-high were then investigated further and a specific vulnerability analysis was performed.

Hazard Priority – King George County

Identified Hazards	Local Hazard Priority
Dam Failure	Low
Drought and Extreme Heat	Medium-High
Wildfires	Medium
Earthquakes	Medium-Low
Sinkholes and Landslides	Low
Flooding and Erosion	Medium-High
Non-Rotational Wind	High
Tornadoes	High
Winter Storms and Nor'easters	High

Drought

According to the National Climatic Data Center, there have been 16 drought events reported in GWRC region between 1993 and 2016. These past occurrences are presented in the following table. Locally, drought impacts include:

- Requests to the Governor for disaster status;
- Voluntary and mandatory reductions in water usage;
- Reduction in crop yields:
- Grazing losses;
- Increase in forest and brush fires; and
- Reduction in streamflow and water table.

With an average occurrence of 0.5 drought events per year, the risk of future drought is ranked as medium.

Wildfire

In evaluating past wildfire events in King George County using data supplied by the Virginia Department of Forestry, it is found that the County has seen approximately 1.9 fire events per year, or 40 documented occurrences since 1993. These past occurrences are presented in the following table. While these past events have not generated large impacts, as a highly rural and forested locality, the risk of future wildfire remains significant. For this reason the probability of future occurrences is ranked as medium.

Flooding

In evaluating the localized threat of floods to King George County, the committee analyzed past flood data from the NOAA to identify incidents that may have posed a threat to the community. These past occurrences are presented in the following table. There have only been eights floods in the area since 1998. The probability of future occurrences is ranked as medium-high.

Non-Rotational Wind (Hurricanes and Thunderstorms)

In evaluating the localized threat of hurricanes to King George County, the NOAA hurricane data was analyzed to identify past storms that may have posed a threat to the community. The analysis included hurricanes, tropical storms, tropical depressions, and extratropical storms which passed through the region and affected the local community. These past occurrences are presented in the following table. Locally, the twelve (12) hurricane and other storm events have caused:

- Heavy rain;
- Gusty and high sustained winds;
- Flooding and property damage; and
- Multiple power outages.

Hurricane Isabel, occurring in 2003, resulted in trees down over every road in the County. Debris removal was the initial problem in getting roads open for use. Several roads took three to four days to clear. There was low to moderate damage to hundreds of homes. Fortunately, no families were displaced, although approximately 200 citizens utilized the shelter during the storm. Ice and water were requested from the State. Power outages around the County lasted for up to 15 days.

Hurricane Frances, occurring in 2004, spawned at least two tornadoes which caused minor damage to five homes in the Berry Planes subdivision. Again in 2004, Hurricane Ivan spawned two tornadoes which caused moderate damage to 25 homes in the Lake Jefferson subdivision and surrounding areas of Igo Road and Little Chatterton Lane.

The probability of future occurrences is ranked as medium. With 12 hurricanes occurring between 1954 and 2016, King George County experiences approximately 0.2 hurricane or tropical storm events per year.

Tornadoes

In evaluating past instances of tornadic activity in King George County, most tornado activity occurred from May to September, although a historic event in February was noted. These past occurrences are presented in the following. Locally, tornadoes have caused:

- Property damage, including the destruction of boats;
- Tree damage and resultant power outages; and
- Loss of life.

Multiple tornadoes during the 2004 season caused damage throughout the County:

- A tornado in Waugh Point Area destroyed one house with three occupants inside, uprooted huge trees, twisted tops out of huge trees, and rolled 15 large boats off trailers at marina. Significant damage was noted to a second house.
- A tornado started at Port Conway near Montigue Baptist Church and continued to Shiloh area. There was moderate damage to the church, extensive tree damage, and debris from trees in roadways.
- A tornado came from Caroline County across the Rappahannock River and moved through the Sealston area just missing the Sealston Elementary school. The tornado continued into Stafford County where there was extensive home damage in a subdivision. Debris from damaged trees caused minor cosmetic damage to some homes.
- A tornado came from Caroline County across Dogue to Rokeby and continued through Lake Jefferson subdivision and down to Little Chatterton Lane. There was moderate damage to 35 homes from falling trees. One home on Windy Hill was partially destroyed when the roof was lifted off and walls blown out of the garage. Debris from trees was moderate except for isolated roads in the Lake Jefferson subdivision, specifically Daws Drive and Igo Road.

The probability of future occurrences is ranked as medium. With 10 tornadoes occurring between 1960 and 2016, King George County experiences approximately 0.2 tornadoes per year.

Winter Storms

In evaluating the localized threat of winter storms to King George County, the committee analyzed local NOAA severe weather to identify storms that may have posed a threat to the community. These past occurrences are presented in the following table. Locally, winter storms have caused:

- Excessive snow, sleet, and freezing rain;
- Multiple traffic accidents and delays;
- Tree and property damage;
- Power outages; and
- Injury and loss of life.

The probability of future occurrences is ranked as medium. With 60 events occurring between 1993 and 2016, King George County experiences approximately 2.6 winter events per year.

Historic Drought Events – King George County

Date	Crop Damage ($)	Descriptions
August 14, 1980	0	Via resolution, King County Board of Supervisors requested that the Governor of Virginia declare King George County a disaster area due to drought.

Date	Crop Damage ($)	Descriptions
September 1, 1983	0	Via resolution, King County Board of Supervisors requested that the Governor of Virginia declare King George County a disaster area due to drought.
September 15, 1988	0	Via resolution, King County Board of Supervisors requested that the Governor of Virginia declare King George County a disaster area due to drought.
August 7, 1995	0	Dry weather, combined with periods of excessive heat, caused some damage to several crops, and limited the production of healthy livestock, during a month-long period that extended through mid-September. August, normally one of the wettest months, was the sixth-driest on record at Washington/National Airport (Arlington County), with barely seven-eighths of an inch (normal: 3.91 inches). Across the region, monthly precipitation averaged one to two inches, with virtually all of it falling before August 7th. The drought continued into mid-September, when it was alleviated somewhat by steady rains late on the 16th and early on the 17th. However, mean temperatures were much lower in September, ironically due to drier air masses, which allowed temperatures to plummet into the 50s on several mornings. Nonetheless, Washington/National broke an all-time record for consecutive days without measurable precipitation, with 33.
February 18, 1997	0	Via resolution, King County Board of Supervisors requested that the Governor of Virginia declare King George County a disaster area due to drought.
August 1, 1998	0	Persistent high pressure brought unusually dry weather during the entire month for much of northern and central Virginia. Only 0.45 inches of rain fell at Washington Dulles Airport, which was significantly less than the normal of 3.94 inches. Similar readings were found across most of central and northern Virginia. The lack of rainfall substantially reduced crop yields. The lack of rainfall also contributed to increasingly dry timber and brush. The U.S. Forest Service reported the George Washington and Jefferson National Forests were twice as dry as normal, and five fires broke out in these parks during the first week of the month. A water emergency was declared in Spotsylvania Co (VAZ056) on the 30th as the Ni River reservoir had neared dangerously low levels.
November 1, 1998	0	This was the fifth month in a row that drought conditions were seen across Northern Virginia. Persistent high pressure over the Southeast U.S. forced rain producing low pressure systems to steer north of the region. Only 0.91 inches of rain fell at Reagan National Airport in Arlington County during the month of November, 2.19 inches below normal. The 5 month total at the airport was only 5.78 inches, 11.38 inches below normal. The independent cities of Fredericksburg received only 1.0 inches. By the end of the month, the Ni Reservoir, main water supply in Spotsylvania County, had only backup reserve water left and was at a record low level. The county was forced to continue mandatory water restrictions and buy additional water from Stafford County. The agricultural community continued to suffer through the second worst drought in the past 100 years. This was the first year the Farm Service Agency had to make direct payments for grazing losses. The drought has also contributed to a nearly unprecedented amount of forest and brush fires. Sixty-five fires were reported across Virginia between November 1st and 20th. Stafford County reported several significant brush fires during the month, and dozens of smaller fires burned in several other locations.
December 1, 1998	0	This was the sixth month in a row that drought conditions were seen across Northern Virginia. Only 1.74 inches of precipitation fell at Washington Reagan National Airport in Arlington County during December, 1.38 inches below normal. In the past 127 years, only one other July through December on record (1930) received less precipitation than the last half of 1998. The 6 month total at the airport was only 7.45 inches, 12.82 inches below normal. The Ni Reservoir, main water supply in Spotsylvania County, remained at a record low level through the month. Mandatory water restrictions continued across the county for the fifth straight month, and on the 8th, county businesses were banned from using water outdoors. The Palmer Index rated Northern Virginia in a severe to extreme drought, and the Governor declared a state of emergency across Virginia on December 1st due to the dry weather and resulting extreme fire danger. An open burning ban continued across Virginia through December 10th.

Date	Crop Damage ($)	Descriptions
May 1, 1999	0	High pressure was the dominant weather feature across Northern Virginia during the month. Conditions on the Shenandoah and Rappahannock River were also extremely dry. Some stations in these two watersheds reported streamflow at or below the 90th percentile exceedence, which rivaled minimum daily mean flow values of the drought of 1980-82. With such low water tables, Spotsylvania County was forced to reinstate voluntary water restrictions. The Ni River Reservoir, main water source for the county, had already dipped 4 inches below the spillway by mid month. The lack of precipitation also played havoc with spring planting and livestock maintenance. Trees were prematurely shedding leaves in orchards, hay and pastureland were wilting, and watering holes and irrigation sources were slowly drying up.
June 1, 1999	0	High pressure was the dominant weather feature across Northern Virginia during the month. This weather pattern directed rain producing low pressure systems north of the region and continued the climatological drought that has gripped the area since last summer. By the last week of June, the Palmer Drought Index, a measure of long term drought conditions, indicated Northern Virginia was in a severe drought. Flows in the Potomac, Shenandoah, and Rappahannock basins, were equal to or slightly below minimum June daily mean flow values recorded during the 1980-82 drought. Many gauging stations reported streamflow at or below the 90 percent exceedence, and a few reported streamflow values at or below the 95th percentile. Streamflow of the Rappahannock River at Fredericksburg was only 14% of normal. With such low water tables, the city of Fredericksburg was forced to start voluntary water restrictions. The Ni River Reservoir, main water source for Spotsylvania County, dipped 16 inches below full by mid month.
July 1, 1999	83.0M	High pressure was the dominant weather feature across Northern Virginia during the month. This forced most rain producing storm systems to steer north of the region and resulted in the continuation of the climatological, meteorological, and hydrological drought that had plagued the area since last summer. Many stations on the Shenandoah and Rappahannock watersheds reported streamflow at or below the 90 percent exceedence, which rivaled minimum daily mean flow values of the drought of 1980-82. The Rappahannock River was approaching 10% of normal flow, and west of Fredericksburg was flowing with just a few feet of water. Twenty miles upstream of Fredericksburg, the river was too shallow for canoes. The Ni River Reservoir, main water source for Spotsylvania County, dipped 4 inches below the spillway by mid month. In addition to agricultural lands, forest and rural vegetation were also dangerously dry. The Virginia Department of Forestry reported a record fire season January through July, 1320 fires burning 6146 acres. This number already exceeded the amount of fires reported in 1998. During the month of July alone, 61 fires burned 280 acres. The Cumulative Severity Index, a measure of fire danger which ranges from 1 to 800, gave Northern Virginia a rating of 628 by month's end. Animal control officials also attributed an increase of wildlife entering populated areas in search of food and water to the drought.
August 1, 1999	41.7M	High pressure was the dominant weather feature across Northern Virginia through the 24th of August. Most rain producing storm systems steered north of the region through the period. This resulted in the continuation of the climatological, meteorological, and hydrological drought which has plagued the area since last summer. Heavy rain fell east of the Blue Ridge Mountains on the 25th and 27th, helping to fill surface reservoirs. Unfortunately, because most of the rain fell in the form of thunderstorm downpours, most of the moisture ran off into rivers before it had the chance to seep into the aquifer supply. Via resolution, on August 17, 1999, the King County Board of Supervisors requested that the Governor of Virginia declare King George County a disaster area due to drought.

Date	Crop Damage ($)	Descriptions
September 1, 1999	5.0M	Rainfall from two land falling hurricanes made a tremendous impact on the drought that plagued the region since the summer of 1998. Across Northern Virginia, the greatest amount of rain fell north of a line from Staunton to Fredericksburg. The water shortage came to an end in this area by mid month. Locations to the south recorded a major increase in water supplies, upgrading their condition from an extreme drought to a mild drought, but not enough rain fell to completely wipe out the shortage. The Ni River Reservoir returned to 71% of its capacity by the end of the month, allowing officials in Spotsylvania County to lift mandatory water restrictions that were in effect for 13 months.
August 6, 2002	0	Via resolution, King County Board of Supervisors requested that the Governor of Virginia declare King George County a disaster area due to drought.
July 17-31, 2007	0	The Mid Atlantic hydrologic service area experienced severe agricultural drought conditions from the middle of July in 2007 through the end of the month in King George County. Some locations averaged as high as six inches below normal. Some jurisdictions restricted water use. Several locations were included in primary natural disaster areas due to reductions in farm production.
September 25-30, 2007	0	The Mid Atlantic hydrologic service area obtained severe agricultural drought conditions from September 25th of 2007 through the end of the month in King George County. Some locations averaged rainfall totals as high as 8 to 10 inches below normal. Severe drought status was obtained in July before conditions slightly improved. Several jurisdictions continued water use restrictions.

Source: National Climatic Data Center, 2016; and local emergency management

VDOF Historic Wildfire Events – King George County

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
03/17/1995	1	0	8,000	Miscellaneous
08/25/1995	1	0	0	Debris Burning
06/26/1997	1	0	0	Miscellaneous
03/27/1998	1	0	0	Debris Burning
03/30/1998	14	500	0	Incendiary
09/06/1998	3	0	60,000	Smoking
05/07/1999	1	0	0	Children
08/24/1999	2	0	0	Smoking
11/17/1999	1	0	0	Debris Burning
01/28/2001	18	0	0	Miscellaneous
02/20/2001	0	0	5,000	Miscellaneous
03/19/2001	2	0	0	Smoking
03/07/2002	5	0	0	Debris Burning—Rural Burner
09/06/2002	2	0	0	Debris Burning—Rural Burner
03/25/2003	0.5	0	85,000	Hot Ashes
04/23/2003	0.2	0	0	Utility Row
04/16/2005	0.7	0	0	Land Clearing

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
03/05/2006	0.3	0	0	Debris Burning—Rural Burner
03/11/2006	0.2	0	0	Debris Burning—Rural Burner
03/13/2006	0.3	0	0	Children—Juvenile
03/19/2006	2	0	215,000	Children—Juvenile
04/05/2006	0.2	0	0	Children—Juvenile
04/03/2007	0.2	0	0	Debris Burning—Rural Burner
04/03/2007	0.1	0	0	Debris Burning—Rural Burner
04/10/2007	0.1	0	0	Debris Burning—Rural Burner
07/02/2007	0.2	0	0	Fireworks
07/11/2007	15	0	75,000	Unknown
02/10/2008	7.8	0	150,000	Debris Burning—Rural Burner
02/10/2008	2.3	0	0	Utility Row—Powerline
02/10/2008	1.8	0	0	Utility Row—Powerline
02/10/2008	1.7	0	0	Debris Burning—Rural Burner
03/26/2008	0.5	0	0	Debris Burning—Rural Burner
03/28/2008	1	0	0	Children—Juvenile
08/17/2009	0.1	0	0	Equipment Use
03/20/2010	0.3	100	100,100	Debris Burning
02/19/2011	9	0	120,000	Debris Burning
04/27/2011	4	0	0	Incendiary
03/19/2015	7	50,000	80,000	Miscellaneous
04/4/2015	1	0	0	Miscellaneous
03/23/2016	0.5	0	141,000	Debris Burning

Source: Virginia Department of Forestry, 2016.

Historic Flood Events—King George County

Date	Event	Comments
January 28, 1998	Flood	An intense and lingering Nor'easter produced a large area of heavy rains across Central and Northeastern Virginia. Many streams in King George County flooded and several road closures occurred.
February 4, 1998	Flood	A powerful nor'easter dropped between 2 and 4 inches of rain across Northern Virginia resulting in widespread minor to moderate flooding. Hundreds of roads were closed across the region. The dam at Lake Jackson was reported to be over 6 feet above flood stage. Several school districts closed for the following day due to the flooding and continued threat of heavy rain. Property damage estimates were 5K.
September 16, 1999	Flash Flood	Hurricane Floyd produced thunderstorms releasing 2 to 5 inches of rain

Date	Event	Comments
		across Northern Virginia. King George County reported numerous felled trees and over 16,000 power outages were reported across Northern Virginia.
July 14, 2000	Flash Flood	A powerful cold front produced heavy rainfall, hail, and winds in excess of 55mph in Northern Virginia. King George County received over 3 inches of rain. Numerous felled trees and closed roads reported.
March 20, 2003	Flood	Across the region of Northern Virginia between 1.5 and 2.5 inches of rain fell. In King George County, water overflowed from ditches onto roads.
September 7, 2011	Flash Flood	Poplar Neck Road was closed due to flash flooding. A trained spotter near the event recorded a storm total of 12.30 inches of rain. Owens Drive at Potomac Drive was closed due to flash flooding. A nearby spotter recorded 8.35 inches of rain.
September 8, 2011	Flash Flood	Numerous roadways were closed throughout the county, with the most concentrated and significant flash flooding occurring around Dahlgren.
September 27, 2011	Flash Flood	A mudslide was caused by flash flooding near Belvedere Drive and Waugh Point Road.

Source: NOAA, 2016

Historic Hurricane Events – King George County

Storm Name	Date	Category	Total Est. Damage	Descriptions
Hazel	October 15, 1954	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Connie	August 12, 1955	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Diane	August 17, 1955	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Camille	September 1960	Hurricane	Unknown	The Free-Lance Star reported massive flooding.
Floyd	September 16, 1999	Tropical Storm	No estimate available.	Gusty winds from 30 to 50 mph 2 to 5 inches of rain 16,000 power outages

Storm Name	Date	Category	Total Est. Damage	Descriptions
Isabel	September 18, 2003	Tropical Storm	Unknown	Trees down over every road in County. High winds to 85 mph sustained with gusts to 101mph. Over 300 emergency calls, low to moderate damage to 100's of homes, no families displaced, almost 200 in shelter during storm, ice and water request from State, power outages Countywide for up to 15 days. Isolated power outages longer. EOC operational for 5 days. Shelters opened for one night. Debris removal initially a problem getting roads open. Some roads took 3-4 days to clear. VDOT debris removal continued for one month. Major damage to infrastructure was County wide. Federal Declaration received. FEMA arrived and individual assistance provided. Major damage to many homes, some not inhabitable. Shelter opened with 85 people sheltered during storm. At least one crab business reportedly flooded.
Charley And Bonnie	August 18, 2004	Hurricane	Unknown	Highest sustained wind was 73 mph Uprooted trees and downed numerous power lines Over 2 million Virginians without power Heavy rain and wind gust 2-4 inches of rain, mild winds, indirect hit to area. No damage noted
Frances	September 8, 2004	Hurricane	Unknown	At least two tornadoes touched down causing minor damage to 5 homes in the Berry Planes subdivision. Other areas affected were woods only. No Presidential Declaration received. Moderate wind gusts and rains. Indirect hit – hurricane.
Ivan	September 17, 2004	Hurricane	Unknown	At least two tornadoes touched down causing moderate damage to 25 homes in the Lake Jefferson subdivision and surrounding areas of Igo Road and Little Chatterton Lane. Other areas affected were woods only. No Presidential Declaration received. Moderate wind gusts and rains. Indirect hit - hurricane.
Jeanne	September 28, 2004	Hurricane	Unknown	2-4 inches of rain and moderate winds across the County. No damage reported. Tornado Watch in affect – none received. Indirect hit.
Gaston	August 30, 2004	Tropical Depression	Unknown	Hard rains that processed flooding Roads under water Power outage (99,600 statewide) 2-4 inches of rain, mild winds, indirect hit to area. No damage noted
Irene	August 27, 2011	Tropical Storm	Unknown	Numerous trees were down. Twenty trees fell into homes and 8 homes sustained major damage.

Source: NOAA 20016, VWC 20016, local emergency management, *The Free Lance and Daily Star.*

Tornado History – King George County

Date	Magnitude	Property Damage ($)	Descriptions
February 18, 1960	F1	0K	
September 5, 1979	F1	250K	
Late 1990's	NA	NA	NSWCDD to Ferry Dock Road in Dahlgren Tornado came through naval base twisting off enormous trees with minor damage to some homes mostly from falling trees. Continued through Ferry Dock Road and across Potomac Drive with tree damage.
July 2, 1999	F1	10K	Parts of southern King George County lost power after downed trees fell onto power lines.
July 10, 2003	F0	0	F0 tornado touched down approximately 5 miles southeast of Falmouth near Route 3 The tornado moved northeast and damaged trees until it lifted near Route 218 on the King George County line
May 7, 2004	F1	10K	At 7:51 p.m., an F1 tornado touched down near Passapatanzy. At least a dozen dwellings and 10 boats were damaged. Several trees were also uprooted or had their tops ripped out along the storm's three-mile path. In Stafford County, 80 to 90 mph winds destroyed two homes and caused major damage to 20 others. The Japazawas Subdivision in eastern Stafford County had approximately 40 trees down. Three Amtrak trains were stalled between the Chatham area of Stafford and Fredericksburg due to downed trees and power lines. In Spotsylvania County, the main stage at the re-enactment of the Battle of Spotsylvania collapsed due to strong winds. A number of tents and a couple of portable toilets were also blown over. Estimated damages were $10,000.
Fall 2004	NA	NA	4 Tornadoes spawned from multiple back to back hurricanes Tornado in Waugh Point Area destroyed one house with three occupants inside, uprooted huge trees, twisted tops out of huge trees, rolled 15 large boats off trailers at marina. Significant damage to a second house. Tornado started at Port Conway near Montigue Baptist Church and continued to Shiloh area. Moderate damage to church, extensive tree damage, Debris from trees in roadways. Tornado came from Caroline County across the Rappahannock River moved through Sealston area just missing Sealston Elementary school. Continued into Stafford County where there was extensive home damage in a subdivision. Debris from damaged trees minor cosmetic damage to some homes. Tornado came from Caroline County across Dogue to Rokeby and continued through Lake Jefferson subdivision and down to Little Chatterton Lane. 35 homes with moderate damage from falling trees, one home on windy hill partially destroyed when roof was lifted off and walls blown out of garage. Two barns destroyed by wind, Little Chatterton with moderate damage from tree falling on home. Not a lot of debris from trees except for isolated roads in Lake Jefferson subdivision Daws Drive and Igo Road.
September 8, 2004	F1	7K	At 3:57 p.m., an F1 tornado moved from Caroline County along the Stafford-King George County line. Numerous large trees up to three feet in diameter were uprooted and had their tops ripped from them along Route 3 near Sealston. The storm was rated an F1 due to the extensive tree damage observed. Damage was estimated at $7,000.

Date	Magnitude	Property Damage ($)	Descriptions
September 17, 2004	F1	500K	Tornado reported in the Fairview Beach area.
June 13, 2013	F0	Unknown	After review of radar observations and a ground survey, The National Weather Service has confirmed a EF-0 tornado touched down in Southeastern King George County on the afternoon of Thursday, June 13, 2013. The tornado touched down in Port Conway, where tree damage occurred just east of US 301. The tornado then traveled east-northeast across southeastern King George County causing intermittent tree damage. The most significant damage occurred Northeast of Rollings Fork near the Westmorland County border where three 20-30 inch diameter Poplar trees were blown over and numerous small trees were topped.

Source: NOAA 2016 and local emergency management; NA = Data not available.

Historic Northeaster and Winter Storm Events – King George County

Date	Event	Property Damage ($)	Comments
December 28, 1993	Heavy Snow	0	
January 28, 1995	Heavy Snow	0	
January 9, 1996	Heavy Snow	0	Low and mid-level lift ahead of an "Alberta Clipper" added insult to injury only a day after the "Blizzard of '96", dumping 4 inches of snow in a 5 hour period near the tidal Potomac River.
January 12, 1996	Heavy Snow	350K	Less than one week after the crippling "Blizzard of '96", a new winter storm dumped substantial snow across northern and western Virginia. In southern Stafford Co (VAZ055), a woman was injured when a carport collapsed. The snow changed to freezing rain and sleet along the tidal Potomac River shortly before tapering off. The changeover suppressed accumulations to 4 or 5 inches in this region. In other portions of northern Virginia, snowfall totals were as follows: in the piedmont, 5 to 7 inches; at higher elevations, 6 to 10 inches. In southern Stafford Co (VAZ055), a woman was injured when a carport collapsed. Luckily, she was protected from serious injury by the automobile, which had its windows shattered.
February 2, 1996	Heavy Snow	0	A vigorous upper level jet stream induced low-level lifting of warm moist air over a stationary arctic front extending from Tidewater Virginia through the Tennessee Valley early on the 2nd, producing a 75 mile-wide band of heavy snow which extended from the central piedmont through the Northern Neck region. The heaviest snows fell in a narrow band from northern Albemarle Co through King George Co. Accumulations in these areas ranged from 8 to 13 inches, and snowfall rates were as high as 3 inches per hour.
February 2, 1996	Heavy Snow	0	The continuation of a strong upper-level jet stream, combined with additional mid-level dynamics, generated surface low pressure over central Georgia by evening on the 2nd. As the low moved to near

Date	Event	Property Damage ($)	Comments
			Cape Hatteras overnight, a broad area of heavy snow overspread all of northern Virginia. Areas that received 4 to 13 inches during an early morning event (on the 2nd) picked up an additional 4 to 6 inches, leaving most areas from the central piedmont through the northern neck with a grand total of 12 to 18 inches.
February 16, 1996	Heavy Snow	0	A strong "Alberta Clipper", diving southeast from the upper Midwest into the deep south, linked up with subtropical moisture lurking along the southeast U.S. coast to develop a classic nor'easter, which moved from northeast South Carolina to off the Virginia Capes during the day on the 16th. As the area of low pressure intensified, it wrapped Atlantic moisture well to the west, where modified arctic air was pouring in from southern Canada. The result was a thin band of heavy snow which extended from southwest Virginia through the upper eastern shore of Maryland.
February 8, 1997	Heavy Snow	25K	A winter storm dumped 4 to 8 inches of heavy, wet snow across all of northern and western Virginia on the 8th.
January 14, 1999	Winter Weather	0	A strong arctic cold front moved slowly southeast across the Mid-Atlantic region from late on the 13th to midday on the 15th. By 9am on the 15th, ice accumulations from one quarter to nearly one inch occurred north of a line from Augusta County to Spotsylvania County. The ice this storm left behind had a large impact on the region. Hundreds of car accidents, slip and fall injuries, downed trees, and power outages were reported. In Stafford County, a jackknifed tractor trailer closed State Route 3 and 621, and Interstate 95 had to be temporarily shut down to clear fallen trees. Over 215,000 customers lost power from the storm across Northern Virginia, and Central Virginia reported over 6,000 additional outages.
March 9, 1999	Winter Storm	0	An area of low pressure moved from the Ohio Valley to North Carolina from late on the 8th through the evening of the 9th. Snowfall rates were in excess of 1 1/2 inches per hour in many locations during the storm. Stafford County received between 4 to 8 inches. Spotsylvania and King George County received between 2 and 6 inches. The city of Fredericksburg reported over 100 accidents. On Interstate 95 in Spotsylvania County, a woman was killed in a morning car accident.
January 20, 2000	Winter Weather	0	An area of low pressure moved from west to east across the Mid-Atlantic region on the 20th, dropping 2 to 6 inches of snow between midnight and mid-afternoon. Gusty winds of 35 to 45 MPH developed during the afternoon causing the snow to drift across roadways and reduce visibilities in open areas.
January 25, 2000	Northeaster	0	Low pressure off Cape Hatteras rapidly intensified late on the 24th and developed into a nor'easter which tracked northward along the Eastern Seaboard on the 25th. Very heavy snow and near-blizzard conditions were seen throughout the day east of the Blue Ridge Mountains, resulting in extremely hazardous travel conditions. Wind gusts of up to 45 MPH were recorded and several roads were drifted shut by blowing snow. The governor of Virginia declared a state of emergency as the storm battered the eastern part of the state.

Date	Event	Property Damage ($)	Comments
January 30, 2000	Ice Storm	0	Cold air was in place east of the Blue Ridge Mountains on the 29th and 30th, keeping surface temperatures below freezing. Low pressure moved from the Lower Mississippi Valley northeastward to the Mid-Atlantic region early on the 30th, creating the perfect conditions for freezing rain around the Fredericksburg area, a mix of sleet and snow east of Skyline Drive, and moderate snowfall in the mountains. Ice accumulations between 1/4 and 3/4 of an inch coated roads, trees, and power lines in Fredericksburg and Stafford, Spotsylvania, and King George Counties. Electrical outages were reported as trees and branches weighed down by ice fell onto power lines. Disruptions affected 3000 customers in Fredericksburg and Spotsylvania and King George Counties.
February 12, 2000	Winter Weather	0	Low pressure moved from Tennessee to the North Carolina Coast on the 12th, spreading snow across the Central Shenandoah Valley and the Northern and Central Piedmont. Periods of light snow occurred from sunrise to late afternoon with accumulations ranging from 1 to 5 inches. A period of freezing drizzle also occurred around sunset.
December 13, 2000	Winter Weather	0	A strong cold front brought chilly air into the region on the 12th. By the afternoon of the 13th, an upper level disturbance brought warm air into the mid levels of the atmosphere and caused snow that fell from the system to melt to rain on its way down. When the rain hit the ground where temperatures were below freezing, ice accumulated.
February 22, 2001	Winter Storm	0	This system produced mainly light to moderate snowfall across the region between 9 AM and 10 PM. Snowfall amounts ranged from 2 to 5 inches. A 50 vehicle crash occurred on the northbound lanes near Masaponax in Spotsylvania County. The accident occurred as motorists crested the top of a hill, hit near zero visibility, and slammed on their breaks. Three people were treated for serious injuries and another 18 suffered minor injuries. The highway remained closed for three hours while the wreckage was cleared. A 30 vehicle pileup occurred on the southbound lanes just north of the Falmouth/Route 17 interchange in Stafford County. As whiteout conditions struck, three cars slid into each other. Within seconds, the minor fender bender turned into a pileup including tractor trailers, cars, trucks, and an empty bus. Three people were injured and the highway was blocked for nearly three hours.
January 3, 2002	Winter Storm	0	Low pressure tracked across extreme southeast Virginia during the morning of the 3rd. This storm brought light to moderate snowfall to the Central Piedmont and Fredericksburg areas between 5 AM and 3 PM. In Stafford County, an inch of snow caused slippery roads and delayed school openings. In Spotsylvania and King George Counties, snowfall totals ranged from 3 to 5 inches.
January 19, 2002	Winter Weather	0	Low pressure that moved across North Carolina on the 19th brought mixed precipitation to the region between 6 AM and 11 PM. In most locations, the precipitation started off in the form of snow, then changed to a mix of sleet and rain around midday.
December 5, 2002	Winter Storm	0	This storm produced accumulating snowfall across the entire region as it moved by. Across the Central Piedmont and Fredericksburg area, freezing rain and sleet was mixed in with the snow. The snow and sleet accumulations ranged from 4 to 6 inches in this area.

Date	Event	Property Damage ($)	Comments
February 6, 2003	Winter Storm	0	Low pressure tracked from the Gulf Coast to the Carolinas on the 6th then off the Atlantic coast on the 7th. This storm dropped light to moderate snow between the evening of the 6th and Noon on the 7th. Accumulations ranged from 3 to 7 inches.
February 14, 2003	Winter Storm	8.9M	A complex storm system produced copious amounts of wintery precipitation across the northern third of Virginia between the evening of the 14th and midday on the 18th. After the precipitation came to an end, record breaking snow and sleet accumulations were reported.
February 26, 2003	Winter Weather/mix	0	A series of low pressure systems that tracked from the Gulf Coast to Cape Hatteras dropped light snow off and on between the morning of the 26th and midday on the 28th. A total of 5 to 8 inches of snow accumulated across the northern third of Virginia during the storm. Minor traffic accidents were reported after the fallen snow made roads slippery.
December 14, 2003	Winter Weather/mix	0	An area of low pressure developed over the Gulf Coast region and tracked northeast into the Mid Atlantic region. The storm produced a mixture of snow, sleet and freezing rain. Snowfall totals across Northeast Virginia averaged 3 to 4 inches.
January 25, 2004	Winter Weather/mix	0	An area of low pressure developed off the coast of North Carolina and tracked north. This storm produced widespread snow, sleet and freezing drizzle over the region. Two to four inches of snow fell over the Central Foothills and the Northern Piedmont of Virginia. The snow mixed with sleet and finally changed over to freezing drizzle before tapering off. Several other minor accidents occurred according to Emergency Operations Centers. Dozens of school districts closed.
December 5, 2005	Heavy Snow	40K	A winter weather storm produced 4 to 6.5 inches of snow across Northern Virginia. There were reports of trees down in due to heavy snow accumulations.
February 11, 2006	Heavy Snow	250K	Storm snowfall across Northern Virginia produced between 8 and 14 inches. There were reports of isolated drifting of snow and downed powerlines throughout the region. This caused over 300,000 customers to be without power in the greater Washington/Baltimore area.
December 19, 2009	Winter Storm	0	Snowfall amounts were reported between 16 and 21 inches across King George County.
January 26, 2011	Winter Storm	0	Snowfall accumulation totaled up to 7.5 inches in Central Virginia. The heavy snow fell in the evening rush hour, causing traffic accidents and stranded vehicles. Numerous power outages were also reported.
January 30, 2010	Winter Storm	0	Snowfall accumulation was between 5 and six inches in King George County.

Date	Event	Property Damage ($)	Comments
January 11, 2011	Winter Weather	0	Low pressure tracked through the Ohio Valley on the 11th before transferring its energy to another area of low pressure off the Mid-Atlantic Coast during the evening hours. A period of snow associated with these systems affected the area during the late afternoon and evening hours of the 11th. Upslope snow continued into the early morning hours of the 12 for locations along and west of the Allegheny front. A trace of freezing rain accumulation was reported across portions of the county.
January 26, 2011	Winter Weather	0	A potent area of low pressure was located over the Tennessee Valley on the morning of Wednesday, January 26th. The warm front associated with the low triggered a period of mixed precipitation early Wednesday morning. There was enough warm air behind the warm front for precipitation to fall in the form of light rain and drizzle later during the late morning into the afternoon. The low passed through the area late in the afternoon into the evening. A burst of heavier precipitation was associated with the low and at the same time colder air was drawn into the system. This caused a period of heavy snow to bring significant snow accumulation to the area in a short period of time. The heavy snow which fell around the evening rush hour caused numerous traffic accidents along with stranded vehicles especially across northern Virginia. Numerous power outages were also reported across northern Virginia where snowfall was the heaviest. Snowfall totaled up to 2.0 inches at Jersey.
March 27, 2011	Winter Weather	0	A wave of low pressure quickly passed by to the south during the morning hours of the 27th. High pressure to the north supplied enough cold air to cause precipitation associated with the low to fall in the form of snow. Snowfall totaled up to 1.5 inches near Jersey.
January 20, 2012	Winter Weather	0	Snow and sleet accumulations were reported to be around four tenths of an at King George. A glaze of ice accumulation from freezing rain was also reported.
February 19, 2012	Winter Weather	0	Low pressure passed by to the south while high pressure to north pumped in cold air. Precipitation associated with the low fell in the form of snow across central Virginia. Snowfall totaled up to 2.1 inches at King George.
March 5, 2012	Winter Weather	0	A potent area of low pressure tracked through southern Virginia during the morning and early afternoon hours of the 5th. A band of precipitation developed on the northern side of the low. There was enough cold air for precipitation to fall in the form of snow, and the heaviest snow was across central Virginia. Snowfall totaled up to 2.8 inches at King George.
January 23, 2013	Winter Weather	0	A positively tilted trough of low pressure moved through the Mid Atlantic while a weak clipper system moved through Central Virginia. Cold temperatures and banding produced advisory level snowfall accumulations. Snowfall amounts of around 2 or 3 inches were reported during the morning rush hour.
March 5, 2013	Winter Weather	0	Strong low pressure impacted the Mid Atlantic bringing rain and snow to the region. A rain-snow line was present across the I-95 corridor where snowfall accumulations dropped off significantly from west to east. Snowfall amounts were estimated to average between two and four inches based on observations nearby.

Date	Event	Property Damage ($)	Comments
March 24, 2013	Winter Weather	0	Coastal low pressure impacted the Mid-Atlantic region with snow and rain showers. Surface temperatures were marginal during the event and a sharp gradient of snowfall accumulation existed near Washington DC. Snowfall amounts were estimated to be between one and three inches across the county based on observations nearby.
December 8, 2013	Winter Weather	0	High pressure was wedged down the east coast and surface temperatures fell below freezing. Low pressure developed across the gulf coast states and moved across the Ohio Valley. Snow began but changed over to sleet and freezing rain as warmer temperatures aloft overran the cold air at the surface. Ice accumulations of around a tenth of an inch fell at surrounding locations.
January 2, 2014	Winter Weather	0	Low pressure tracked across the Mid-Atlantic and led to accumulating snow with the highest amounts from Northern Virginia to East-Central Maryland. Low pressure quickly moved off the coast. Snow accumulations of two inches or more were measured at surrounding locations.
January 10, 2014	Winter Weather	0	A weak disturbance crossed the Mid Atlantic while a wedge of high pressure was at the surface. Precipitation that fell melted aloft and froze on contact. Ice accumulations of a trace or more were measured at surrounding locations.
January 21, 2014	Winter Weather	0	A shortwave trough moved into the region while low pressure developed south of the Mid Atlantic. Upper level dynamics led to moderate to heavy snow to move into the region. Snow accumulations of two inches or more were measured at surrounding locations.
January 28, 2014	Winter Weather	0	Low pressure moved along the east coast while a shortwave trough moved into the Mid Atlantic from the west. Accumulating snow moved into the Piedmont and Southern Maryland. Snow accumulations of four inches were measured at Dahlgren.
February 4, 2014	Winter Weather	0	A wedge of high pressure extended southwest along the Appalachian Mountains. Low pressure approached the Mid Atlantic from the Tennessee Valley and warm air overran colder air at the surface resulting in freezing rain. Ice accumulation of a trace or more was reported at surrounding locations.
February 12, 2014	Winter Storm	0	Low pressure moved up the east coast and approached the Mid Atlantic. High pressure was located across New England and fed cold air into the region. Heavy snow fell across most parts of the Mid Atlantic with the highest amounts near the Mason Dixon line where mid-level forcing led to a heavy band. Snow accumulations of 6 or more inches were measured at King George.
February 13, 2014	Winter Weather	0	An upper low moved into the Mid-Atlantic and mid-level forcing led to snow across portions of the Mid Atlantic. Wrap around moisture around the surface low and dynamics from the upper low led to snow fall accumulation across Washington DC metro and Southern Maryland. Snow accumulations of 2 inches or more measured at surrounding locations.
February 25, 2014	Winter Weather	0	A upper level disturbance moved across the region in the morning. Temperatures were well below freezing and snow showers accumulated on surfaces. Snow became heavier across the Washington DC metro and Southern Maryland. Snow accumulations of two inches or more were measured at surrounding locations.

Date	Event	Property Damage ($)	Comments
March 3, 2014	Winter Storm	0	A cold front crossed the region as low pressure passed across the south of the Mid Atlantic and heavy snow moved across the region. Temperatures dropped from north to south and precipitation changed from rain to sleet/freezing rain to snow. Snow accumulations of five or more inches was measured at surrounding locations.
March 7, 2014	Winter Weather	0	High pressure extended across the spine of the Appalachian Mountains. A surface low moved up the east coast from Georgia and precipitation entered the Central Foothills and Piedmont early in the morning. Below freezing temperatures led to freezing rain across this area including Southern Maryland. Ice accumulation of a trace was reported at surrounding locations.
March 16, 2014	Winter Storm	0	Two areas of low pressure formed south of the Mid Atlantic. Dry and cold air at the surface led to precipitation to quickly change to snow. Heavy snow fell across the region with a confined area of greater than 10 inches across the Central Foothills. Snow accumulation of five or more inches was measured at Dahlgren.
March 18, 2014	Winter Weather	0	A wedge of high pressure was across the Mid Atlantic. Low level moisture and sub freezing temperatures led to freezing drizzle and freezing rain across the Central Foothills, Shenandoah Valley, Piedmont and Southern Maryland. Ice accumulation of a trace was reported at surrounding locations.
March 25, 2014	Winter Weather	0	Low pressure moved past the Mid Atlantic from the Carolinas. High pressure to the north fed freezing temperatures to the region resulting in snow to accumulate across the region. Snowfall occurred during the morning rush for the Baltimore/Washington DC and Interstate 95 corridor. Snow accumulation of 2 inches or more was measured at surrounding locations.
February 16, 2015	Winter Storm	0	A surface low formed over Texas, then quickly moved east during the day and overnight, pushing off the Carolina coast by the morning of the 17th. A very cold airmass in place from retreating Arctic high pressure resulted in higher than average snow ratios, between 12:1 and 15:1. Central Virginia received the highest amounts, with lower amounts to the north and west. Between 5.0 and 7.0 inches was reported by multiple sources in the county and surrounding areas.
February 21, 2015	Winter Weather	0	Low pressure lifting from the Ohio River Valley into the eastern Great Lakes dragged a cold front through the region. Southerly flow ahead of the front resulted in high moisture advection and with temperatures hovering in the 20s, moderate to heavy snow was reported across the region. Between 2.0 and 3.0 inches was reported in surrounding areas.
February 25, 2015	Winter Storm	0	Low pressure passing to the south brought widespread snow. Spotter in Shiloh reported 6.0 inches. Between 4.0 and 5.0 inches was reported around the county.
March 1, 2015	Ice Storm	0	Storm total ice of 0.25 inches was reported near Fairview Beach.
March 3, 2015	Winter Weather	0	Storm total ice between a trace and a tenth of an inch of ice was reported in surrounding areas.
March 5, 2015	Winter Storm	0	A cold front brought widespread heavy snow to the area with a strong convergence zone aligning across northern Virginia into eastern Maryland resulting in mesoscale banding and higher snow totals. Storm total snow between 5.0 and 6.0 inches was reported around the county and in surrounding areas.

Date	Event	Property Damage ($)	Comments
January 22, 2016	Winter Storm	0	Coastal low pressure rapidly intensified as it tracked up the Mid-Atlantic coast. At the same time, high pressure to the north was funneling cold air into the region. The strong low pressure system was able to tap into moisture from the Gulf of Mexico and the Atlantic Ocean resulting in heavy amounts of precipitation. The cold air caused that precipitation to fall in the form of snow. Gusty winds also accompanied this storm. The combination of gusty winds and low visibility along with snow and blowing snow caused blizzard conditions across portions of northern Virginia. Snowfall totaled up to 16.0 near Shiloh and 14.0 in Jersey.
February 14, 2016	Winter Storm	0	Prolonged event impacted the Mid-Atlantic. Southwest flow aloft overriding northeast flow at the surface from departing high pressure led to snow spreading over the region initially. Low pressure formed and organized over the Gulf of Mexico, eventually pushing off to the northeast and impacting the region on the 15th. As the cold air wedge was eroded away from this low, warming at all levels led to the snow transitioning to sleet and ice for most of the area. Between 5 and 8 inches of snow was reported.

Source: National Climatic Data Center, 2016.

4.3.4 - Spotsylvania County Hazard Identification

For the 2017 plan update, the committee reviewed the Commonwealth of Virginia Hazard Mitigation Plan, as well as hazard events over the preceding five years, to determine the relative risk and priority (high, medium, or low) of various hazards as they specifically affect the locality. These hazards and their local priorities are presented in the chart below. For hazards that ranked high and medium-high were then investigated further and a specific vulnerability analysis was performed.

Hazard Priority – Spotsylvania County

Identified Hazards	Local Hazard Priority
Dam Failure	Low
Drought and Extreme Heat	Medium
Wildfires	Medium
Earthquakes	Medium-Low
Sinkholes and Landslides	Low
Flooding and Erosion	High
Non-Rotational Wind	High
Tornadoes	Medium-High
Winter Storms and Nor'easters	High

Drought

Past drought occurrences in Spotsylvania County are presented in the following table. Locally, droughts have caused:

- Requests to the Governor for disaster status;
- Voluntary and mandatory reductions in water usage;
- Reduction in crop yields:
- Grazing losses;
- Increase in forest and brush fires; and
- Reduction in streamflow and water table.

There have been 11 incidents of drought that affected Spotsylvania County in a 21 year period from 1995 to 2016, or about 0.5 droughts per year. The probability of future occurrence is ranked as medium.

Wildfires

In evaluating the localized threat of wildfires to Spotsylvania County, this plan relies on data from the Virginia Department of Forestry to identify past incidents that posed a threat to the community. The past occurrences are presented in the following table. There have been 263 recorded wildfire events in the

County since 1995, or approximately 12.5 fires per year. Therefore, the probability of future occurrences is rated as medium.

Flooding

In evaluating the localized threat of floods to Spotsylvania County, the committee analyzed NOAA data from 1951 to 2011 to identify incidents of flooding that may have posed a threat to the community. The analysis included both floods and flash floods. The past occurrences are presented in the following table. There have been 28 flooding events in Spotsylvania County since 1993. That's an average of 1.22 floods per year. Therefore, the probability of future occurrences is rated as high.

Non-Rotational Wind (Hurricanes and Thunderstorms)

In evaluating the localized threat of hurricanes and other tropical storms to Spotsylvania County, the committee analyzed local emergency management data and NOAA hurricane track data to identify storms that may have posed a threat to the community. The analysis included hurricanes, tropical storms, tropical depressions, and extratropical storms which passed through the region and affected the local community. These past occurrences are presented in the included table. Locally, the 12 hurricanes have caused:

- Heavy rain;
- Gusty and high sustained winds;
- Flooding and property damage;
- Road closures; and
- Multiple power outages.

The probability of future occurrences is ranked as medium, as a result of 12 hurricanes occurring between 1954 and 2016, Spotsylvania County experiences approximately 0.19 hurricanes per year.

Tornadoes

In evaluating the localized threat of tornadoes to Spotsylvania, this planning process analyzed local emergency management data and NOAA severe weather data to identify storms that may have posed a threat to the community. Most tornado activity occurred from May to September, although a historic event in February was noted. These past occurrences are presented in the table below. Locally, the 13 tornadoes have caused:

- Property damage, including the destruction of mobile homes;
- Damage to the stage of the re-enactment of the Battle of Spotsylvania;
- Tree damage and resultant power outages; and
- Personal injury.

The probability of future occurrences is ranked as medium. With 13 tornadoes occurring between 1960 and 2016, Spotsylvania County experiences approximately 0.23 tornadoes per year.

Winter Storms

In analyzing NOAA severe weather data to identify storms that may have posed a threat to the community, the past winter storms charted in the table below have caused:

- Excessive snow, sleet, and freezing rain;
- Multiple traffic accidents and delays;
- Tree and property damage;
- Power outages; and
- Injury and loss of life.

A noted ice storm occurring during 1993 left one-third of the County without power for up to seven days. Two emergency shelters were utilized.

The probability of future occurrences is ranked as medium. With 61 events occurring between 1993 and 2016, Spotsylvania County experiences approximately 2.65 winter events per year.

Historic Drought Events – Spotsylvania County

Date	Crop Damage ($)	Descriptions
August 7, 1995	0	Dry weather, combined with periods of excessive heat, caused some damage to several crops, and limited the production of healthy livestock, during a month-long period that extended through mid-September. August, normally one of the wettest months, was the sixth-driest on record at Washington/National Airport (Arlington County), with barely seven-eighths of an inch (normal: 3.91 inches). Across the region, monthly precipitation averaged one to two inches, with virtually all of it falling before August 7th. The drought continued into mid-September, when it was alleviated somewhat by steady rains late on the 16th and early on the 17th. However, mean temperatures were much lower in September, ironically due to drier air masses, which allowed temperatures to plummet into the 50s on several mornings. Nonetheless, Washington/National broke an all-time record for consecutive days without measurable precipitation, with 33.
August 1, 1998	0	Persistent high pressure brought unusually dry weather during the entire month for much of northern and central Virginia. Only 0.45 inches of rain fell at Washington Dulles Airport, which was significantly less than the normal of 3.94 inches. Similar readings were found across most of central and northern Virginia. The lack of rainfall substantially reduced crop yields. The lack of rainfall also contributed to increasingly dry timber and brush. The U.S. Forest Service reported the George Washington and Jefferson National Forests were twice as dry as normal, and five fires broke out in these parks during the first week of the month. A water emergency was declared in Spotsylvania Co (VAZ056) on the 30th as the Ni River reservoir had neared dangerously low levels.

Date	Crop Damage ($)	Descriptions
November 1, 1998	0	This was the fifth month in a row that drought conditions were seen across Northern Virginia. Persistent high pressure over the Southeast U.S. forced rain producing low pressure systems to steer north of the region. Only 0.91 inches of rain fell at Reagan National Airport in Arlington County during the month of November, 2.19 inches below normal. The 5 month total at the airport was only 5.78 inches, 11.38 inches below normal. The independent cities of Fredericksburg received only 1.0 inches. By the end of the month, the Ni Reservoir, main water supply in Spotsylvania County, had only backup reserve water left and was at a record low level. The county was forced to continue mandatory water restrictions and buy additional water from Stafford County. The agricultural community continued to suffer through the second worst drought in the past 100 years. This was the first year the Farm Service Agency had to make direct payments for grazing losses. The drought has also contributed to a nearly unprecedented amount of forest and brush fires. Sixty-five fires were reported across Virginia between November 1st and 20th. Stafford County reported several significant brush fires during the month, and dozens of smaller fires burned in several other locations.
December 1, 1998	0	This was the sixth month in a row that drought conditions were seen across Northern Virginia. Only 1.74 inches of precipitation fell at Washington Reagan National Airport in Arlington County during December, 1.38 inches below normal. In the past 127 years, only one other July through December on record (1930) received less precipitation than the last half of 1998. The 6 month total at the airport was only 7.45 inches, 12.82 inches below normal. The Ni Reservoir, main water supply in Spotsylvania County, remained at a record low level through the month. Mandatory water restrictions continued across the county for the fifth straight month, and on the 8th, county businesses were banned from using water outdoors. The Palmer Index rated Northern Virginia in a severe to extreme drought, and the Governor declared a state of emergency across Virginia on December 1st due to the dry weather and resulting extreme fire danger. An open burning ban continued across Virginia through December 10th.
May 1, 1999	0	High pressure was the dominant weather feature across Northern Virginia during the month. Conditions on the Shenandoah and Rappahannock River were also extremely dry. Some stations in these two watersheds reported streamflow at or below the 90th percentile exceedance, which rivaled minimum daily mean flow values of the drought of 1980-82. With such low water tables, Spotsylvania County was forced to reinstate voluntary water restrictions. The Ni River Reservoir, main water source for the county, had already dipped 4 inches below the spillway by mid month. The lack of precipitation also played havoc with spring planting and livestock maintenance. Trees were prematurely shedding leaves in orchards, hay and pastureland were wilting, and watering holes and irrigation sources were slowly drying up.
June 1, 1999	0	High pressure was the dominant weather feature across Northern Virginia during the month. This weather pattern directed rain producing low pressure systems north of the region and continued the climatological drought that has gripped the area since last summer. By the last week of June, the Palmer Drought Index, a measure of long term drought conditions, indicated Northern Virginia was in a severe drought. Flows in the Potomac, Shenandoah, and Rappahannock basins, were equal to or slightly below minimum June daily mean flow values recorded during the 1980-82 drought. Many gauging stations reported streamflow at or below the 90 percent exceedance, and a few reported streamflow values at or below the 95th percentile. Streamflow of the Rappahannock River at Fredericksburg was only 14% of normal. With such low water tables, the city of Fredericksburg was forced to start voluntary water restrictions. The Ni River Reservoir, main water source for Spotsylvania County, dipped 16 inches below full by mid month.

Date	Crop Damage ($)	Descriptions
July 1, 1999	83.0M	High pressure was the dominant weather feature across Northern Virginia during the month. This forced most rain producing storm systems to steer north of the region and resulted in the continuation of the climatological, meteorological, and hydrological drought that had plagued the area since last summer. Many stations on the Shenandoah and Rappahannock watersheds reported streamflow at or below the 90 percent exceedance, which rivaled minimum daily mean flow values of the drought of 1980-82. The Rappahannock River was approaching 10% of normal flow, and west of Fredericksburg was flowing with just a few feet of water. Twenty miles upstream of Fredericksburg, the river was too shallow for canoes. The Ni River Reservoir, main water source for Spotsylvania County, dipped 4 inches below the spillway by mid month. In addition to agricultural lands, forest and rural vegetation were also dangerously dry. The Virginia Department of Forestry reported a record fire season January through July, 1320 fires burning 6146 acres. This number already exceeded the amount of fires reported in 1998. During the month of July alone, 61 fires burned 280 acres. The Cumulative Severity Index, a measure of fire danger which ranges from 1 to 800, gave Northern Virginia a rating of 628 by month's end. Animal control officials also attributed an increase of wildlife entering populated areas in search of food and water to the drought.
August 1, 1999	41.7M	High pressure was the dominant weather feature across Northern Virginia through the 24th of August. Most rain producing storm systems steered north of the region through the period. This resulted in the continuation of the climatological, meteorological, and hydrological drought which has plagued the area since last summer. Heavy rain fell east of the Blue Ridge Mountains on the 25th and 27th, helping to fill surface reservoirs. Unfortunately, because most of the rain fell in the form of thunderstorm downpours, most of the moisture ran off into rivers before it had the chance to seep into the aquifer supply.
September 1, 1999	5.0M	Rainfall from two land falling hurricanes made a tremendous impact on the drought that plagued the region since the summer of 1998. Across Northern Virginia, the greatest amount of rain fell north of a line from Staunton to Fredericksburg. The water shortage came to an end in this area by mid month. Locations to the south recorded a major increase in water supplies, upgrading their condition from an extreme drought to a mild drought, but not enough rain fell to completely wipe out the shortage. The Ni River Reservoir returned to 71% of its capacity by the end of the month, allowing officials in Spotsylvania County to lift mandatory water restrictions that were in effect for 13 months.
July 17-30, 2007	0	The Mid Atlantic hydrologic service area experienced severe agricultural drought conditions from mid July through the end of the month. This area included Spotsylvania, Stafford, and King George Counties. Some locations averaged six inches below normal, leading to some jurisdictions restricting water use. Damage estimates were not available due to current harvest progress. Several locations were included in primary natural disaster areas due to reductions in farm production.
September 25-30, 2007	0	The Mid Atlantic hydrologic service area experienced severe agricultural drought conditions from September 25th through the end of the month. This area included Spotsylvania, King George, and Stafford Counties. Some locations received as much as 10 inches below normal, leading to continued restrictions on water use. Damage estimates were not available. Several locations were included in primary natural disaster areas due to reductions in farm production.

Source: National Climatic Data Center, 2016.

Historic Wildfire Events – Spotsylvania County

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
01/14/1995	2	0	0	Smoking
02/22/1995	2	0	180,000	Children
02/23/1995	20	2,700	300,800	Debris Burning
02/24/1995	1	1,000	2000	Incendiary
03/14/1995	1	400	100,000	Debris Burning
03/17/1995	1	100	0	Children
03/17/1995	1	800	29,000	Debris Burning
03/19/1995	1	0	200,000	Incendiary
03/22/1995	1	250	0	Children
03/26/1995	1	0	0	Smoking
03/27/1995	1	100	0	Debris Burning
03/31/1995	1	300	205,000	Debris Burning
04/02/1995	4	100	201,400	Children
04/02/1995	1	100	0	Children
04/04/1995	3	1,000	0	Smoking
04/08/1995	2	5,700	31,000	Miscellaneous
04/08/1995	1	5,000	450,000	Children
04/15/1995	1	500	40,000	Children
04/21/1995	1	200	0	Smoking
04/27/1995	1	200	0	Debris Burning
03/05/1996	1	100	0	Children
03/13/1996	3	0	90,000	Debris Burning
03/16/1996	2	0	200,000	Smoking
03/23/1996	2	0	0	Debris Burning
03/25/1996	2	0	310,000	Debris Burning
03/25/1996	1	100	300,000	Debris Burning
04/08/1996	1	0	80,000	Children
04/08/1996	1	500	75,000	Miscellaneous
04/19/1996	1	700	600,000	Children
04/23/1996	7	10,500	2,000	Debris Burning
04/23/1996	3	0	500,000	Miscellaneous
04/25/1996	2	300	162,000	Debris Burning
02/19/1997	2	100	200,000	Miscellaneous
02/21/1997	1	0	0	Smoking
02/25/1997	4	0	0	Smoking
03/06/1997	1	0	0	Miscellaneous
03/11/1997	2	200	60,500	Debris Burning
03/11/1997	1	0	0	Smoking
03/12/1997	1	0	0	Children
03/12/1997	1	100	50	Miscellaneous

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
03/16/1997	1	200	150,000	Debris Burning
03/24/1997	2	400	40,000	Debris Burning
03/27/1997	1	0	500,000	Children
03/30/1997	1	100	0	Children
04/01/1997	4	200	20,000	Children
04/01/1997	2	400	550,000	Equipment Use
04/02/1997	3	500	500	Children
04/03/1997	3	0	50,000	Smoking
04/07/1997	5	500	100,500	Debris Burning
04/19/1997	1	150	0	Smoking
04/30/1997	2	400	0	Children
05/12/1997	1	300	90,000	Debris Burning
05/20/1997	5	0	0	Debris Burning
05/28/1997	3	400	0	Smoking
07/14/1997	1	100	400	Smoking
08/01/1997	1	0	0	Debris Burning
08/29/1997	1	0	0	Railroad
03/14/1998	2	50	5,025	Debris Burning
03/29/1998	4	0	0	Debris Burning
03/29/1998	1	0	0	Children
04/02/1998	1	100	0	Debris Burning
04/06/1998	2	0	0	Debris Burning
04/07/1998	1	100	0	Children
04/13/1998	1	0	0	Children
04/13/1998	1	400	0	Children
04/13/1998	1	200	0	Children
08/05/1998	7	100	160,000	Debris Burning
08/06/1998	1	0	0	Miscellaneous
09/06/1998	2	0	0	Debris Burning
09/07/1998	2	0	0	Children
09/09/1998	1	100	80,000	Lightning
10/18/1998	1	900	0	Smoking
10/28/1998	2	500	305,000	Debris Burning
11/01/1998	1	500	1,000,000	Campfire
11/02/1998	1	500	0	Miscellaneous
11/08/1998	1	100	0	Children
11/28/1998	1	100	0	Incendiary
11/30/1998	4	100	190,000	Debris Burning
12/01/1998	1	500	0	Campfire
12/02/1998	1	500	2,000,000	Children
12/19/1998	1	0	80,000	Children
03/18/1999	38	1,200	300,000	Debris Burning

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
03/28/1999	2	500	315,000	Debris Burning
03/28/1999	1	100	750,000	Smoking
03/30/1999	2	0	0	Equipment Use
03/31/1999	8	2,000	305,000	Debris Burning
04/14/1999	3	800	0	Smoking
04/17/1999	6	2,200	3,000	Smoking
04/17/1999	2	200	311,000	Smoking
05/11/1999	1	0	2,000	Smoking
05/21/1999	1	200	0	Children
08/05/1999	30	5,000	505,000	Debris Burning
08/07/1999	1	400	75,000	Children
08/08/1999	2	0	0	Children
08/11/1999	1	0	0	Equipment Use
11/07/1999	3	100	0	Children
11/16/1999	3	100	255,000	Miscellaneous
01/13/2000	3	500	250,500	Miscellaneous
02/25/2000	1	0	0	Miscellaneous
03/04/2000	1	0	0	Incendiary
03/05/2000	3	200	0	Campfire
03/05/2000	1	0	0	Campfire
03/15/2000	1	400	150,000	Debris Burning
03/27/2000	1	0	0	Children
03/31/2000	1	500	20,000	Debris Burning
04/01/2000	2	500	102,000	Debris Burning
04/01/2000	1	6,500	12,000	Debris Burning
04/13/2000	1	0	100	Equipment Use
10/18/2000	1	0	73,000	Debris Burning
01/30/2001	10	1,000	100,000	Miscellaneous
01/30/2001	4	1,500	303,500	Debris Burning
01/30/2001	2	0	0	Miscellaneous
01/30/2001	1	0	0	Debris Burning
04/10/2001	13	1,000	0	Incendiary
04/10/2001	1	700	400	Debris Burning
04/15/2001	9	250	0	Debris Burning
04/19/2001	1	200	0	Children
04/20/2001	2	200	115,000	Debris Burning
04/22/2001	9	400	0	Incendiary
04/30/2001	1	0	0	Debris Burning
07/16/2001	4	1,000	0	Miscellaneous
07/16/2001	1	0	0	Debris Burning
07/17/2001	1	0	0	Smoking
08/20/2001	17	500	0	Incendiary

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
10/22/2001	5	0	0	Campfire
11/05/2001	3	100	1,000	Debris Burning
11/06/2001	1	50	130,000	Debris Burning
11/12/2001	2	300	0	Miscellaneous
11/12/2001	1	500	60,000	Smoking
11/14/2001	1	1,000	0	Incendiary
11/17/2001	1	0	0	Smoking
04/10/2001	1	700	400	Debris Burning
04/15/2001	9	250	0	Debris Burning
02/01/2002	1	0	100,000	Utility Row
02/04/2002	1	0	0	Prescribed Burn
02/17/2002	0.2	0	0	Hot Ashes
02/27/2002	0.1	0	1,000,000	Incendiary
02/28/2002	0.1	0	600,000	Incendiary
02/28/2002	0.1	0	600,000	Incendiary
02/28/2002	0.2	0	750,000	Incendiary
03/01/2002	0.2	0	200,000	Hot Ashes
03/05/2002	1	0	500,000	Truck Fire
03/06/2002	2	0	0	Children—Juvenile
03/10/2002	10	1,500	625,000	Debris Burning—Rural Burner
03/15/2002	2	50,000	0	Debris Burning—Stump Pile
04/02/2002	0.1	0	0	Incendiary
04/04/2002	1	0	0	Children—Juvenile
04/08/2002	4	1,000	300,000	Debris Burning—Rural Burner
04/14/2002	3	100	100,000	Children—Juvenile
04/17/2002	1	300	0	Incendiary—Automobile
05/24/2002	0.1	200	0	Incendiary—Automobile
05/31/2002	0.2	200	0	Incendiary—Automobile
06/07/2002	2	1,000	100,000	Lightning
06/12/2002	3	500	250,000	Incendiary
06/20/2002	6	0	0	Prescribed Burn
06/22/2002	7	1,000	0	Prescribed Burn
06/24/2002	4	0	0	Debris Burning—Rural Burner
07/11/2002	2	500	50,000	Smoking
07/12/2002	0.2	0	0	Debris Burning—Rural Burner
07/22/2002	4	2,000	0	Prescribed Burn
07/23/2002	1	200	0	Debris Burning—Rural Burner
08/092002	1	0	80,000	Debris Burning—Rural Burner
08/18/2002	0.1	100	0	Equipment Use—Vehicle Brake
01/26/2003	0.2	0	100,000	Debris Burning—Rural Burner
03/24/2003	0.1	0	230,000	Debris Burning—Urban Burner
03/25/2003	1	0	250,000	Children—Juvenile

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
04/06/2003	1	0	100,000	Children—Juvenile
10/02/2003	3	0	0	Children—Juvenile
11/13/2003	1.5	0	0	Utility Row
2/23/2004	0.2	0	0	Children—Juvenile
02/29/2004	1	0	0	Debris Burning—Rural Burner
03/03/2004	0.2	0	150,000	Debris Burning—Rural Burner
03/12/2004	9	0	1,000,000	Children—Juvenile
03/21/2004	0.1	0	0	Children—Juvenile
03/25/2004	0.1	0	0	Unknown
03/07/2005	2	0	400,000	Incendiary—Juvenile
03/07/2005	4	0	0	Incendiary—Juvenile
03/19/2005	2	0	0	Incendiary
03/19/2005	2	0	0	Children—Juvenile
03/20/2005	0.2	0	100,000	Children—Child Age Under 7
03/22/2005	0.1	0	200,000	Debris Burning—Rural Burner
04/16/2005	1	0	0	Debris Burning—Rural Burner
4/26/2005	0.1	0	0	Children—Juvenile
05/10/2005	2	0	0	Debris Burning—Rural Burner
06/20/2005	2	400	0	Land Clearing
3/5/2006	0.1	0	250,000	Unknown
03/09/2006	3	0	0	Land Clearing
03/09/2006	0.1	0	0	Debris Burning—Rural Burner
03/132006	1	0	0	Children—Juvenile
03/13/2006	2	0	0	Hot Ashes
03/13/2006	0.2	0	0	Hot Ashes
03/15/2006	0.6	0	800,000	Utility Row
03/18/2006	2	0	0	Debris Burning—Rural Burner
03/19/2006	0.2	0	3,000,000	Incendiary—Juvenile
03/19/2006	0.1	0	600,000	Smoking
03/19/2006	0.1	0	0	Children—Child Under Age 7
03/25/2006	0.1	0	0	Children—Juvenile
03/27/2006	0.2	0	100,000	Debris Burning—Rural Burner
03/27/2006	0.2	0	0	Debris Burning—Rural Burner
04/01/2006	0.1	0	0	Debris Burning—Rural Burner
04/02/2006	0.2	0	0	Children—Juvenile
04/19/2006	0.2	0	300,000	Debris Burning—Rural Burner
05/03/2006	3	0	900,000	Smoking—Construction
02/23/2007	0.2	0	200,000	Children—Juvenile
03/08/2007	0.4	0	0	Children—Juvenile
03/10/2007	0.2	0	500,000	Debris Burning—Rural Burner
03/13/2007	4	0	300,000	Debris Burning—Rural Burner
03/13/2007	0.1	0	0	Equipment Use—Lawnmower

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
03/29/2007	1	0	150,000	Smoking—Automobile
03/29/2007	0	0	0	Incendiary—Juvenile
03/31/2007	0	0	200,000	Debris Burning—Rural Burner
04/02/2007	0.1	0	0	Debris Burning—Urban Burner
04/04/2007	0.5	0	0	Incendiary—Automobile
04/23/2007	0.1	0	0	Debris Burning—Rural Burner
04/24/2007	0.1	0	0	Children—Juvenile
07/13/2007	0.2	0	700,000	Children—Juvenile
09/10/2007	2	0	0	Debris Burning—Rural Burner
10/16/2007	0.7	0	0	Children—Juvenile
10/21/2007	0.1	0	0	Children—Juvenile
02/10/2008	1	0	0	Debris Burning—Rural Burner
02/10/2008	0.2	0	700,000	Debris Burning—Rural Burner
02/10/2008	2.7	0	0	Utility Row
02/11/2008	2	0	500,000	Utility Row
02/19/2008	1	0	500,000	Utility Row
03/02/2008	0.2	0	750,000	Children—Juvenile
03/21/2008	1	0	0	Utility Row
03/21/2008	0.1	0	175,000	Children—Juvenile
03/22/2008	0	0	400,000	Children—Juvenile
03/28/2008	0.2	0	0	Debris Burning—Rural Burner
04/15/2008	0.1	0	0	Debris Burning—Rural Burner
04/15/2008	0.1	0	0	Incendiary
05/05/2008	2.5	1,000	0	Equipment Use
03/7/2010	0	0	400,000	Debris Burning
03/8/2010	0	0	0	Debris Burning
03/9/2010	0.1	0	0	Children
03/25/2010	1	5,000	305,000	Miscellaneous
04/3/2010	0.1	0	0	Equipment Use
04/5/2010	2	0	0	Equipment Use
04/5/2010	1	0	675,000	Debris Burning
04/5/2010	0	0	0	Equipment Use
04/7/2010	3	0	0	Debris Burning
04/7/2010	1	0	0	Equipment Use
04/7/2010	1	0	0	Equipment Use
04/7/2010	1	0	0	Equipment Use
04/8/2010	1	1,500	456,000	Children
04/8/2010	1	0	780,000	Debris Burning
04/14/2010	1	500	185,000	Debris Burning
04/17/2010	8	0	400,000	Miscellaneous
06/28/2010	0.5	0	0	Miscellaneous

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
07/4/2010	0.1	0	80,000	Debris Burning
07/4/2010	1	0	280,000	Debris Burning
01/14/2011	4	0	0	Children
02/19/2011	1	0	900,000	Miscellaneous
02/19/2011	1	1,500	401,500	Miscellaneous
02/19/2011	1	500	460,000	Miscellaneous
04/25/2011	1	0	0	Debris Burning
03/13/2015	4	500	0	Railroad
04/5/2015	3	250	184,500	Incendiary
04/6/2015	5	500	0	Children
07/6/2015	1	100	0	Children
09/19/2015	1.5	10,000	74,000	Debris Burning
03/19/2016	0.2	500	2,000	Debris Burning
03/23/2016	19	500	0	Children
04/18/2016	0.5	0	17,400	Miscellaneous

Source: Virginia Department of Forestry, 2016

Historic Flood Events – Spotsylvania County

Date	Event	Comments
April 16, 1993	Flash Flood	N/A
January 19-22, 1996	Flood	River flooding occurred across the Commonwealth of Virginia starting in the early morning of January 19th. Snowmelt with a liquid equivalency of 2 to 3 inches combined with another 1 to 3 inches of rainfall caused the worst regional flooding in over a decade. River flooding began at the headwaters of all basins, continuing downstream for the next 3 days. Crests ranged from 3 to 21 feet above the flood stage. High water caused millions in damages, closed roads, destroyed homes and businesses, and even forced the evacuation of several towns. Total property damage estimates were at 15 million and crop damages were at 81K.
June 18, 1996	Flash Flood	Thunderstorms in Spotsylvania County produced residential and small stream flooding in the central region of the county. In the subdivision of Spotslee, water was reported at least 2 feet high. Further west, several small streams were out of their banks. Total property damage estimates were 10K.

Date	Event	Comments
January 28, 1998	Flood	A nor'easter lingering in the area produced heavy rains across the central and northeastern regions of Virginia. Widespread minor to moderate flooding of small streams, creeks, and low-lying areas occurred across the Northern Neck of Virginia. The Virginia Department of Transportation reported over 150 roads closed in the area due to standing water or creeks that exceeded bank full. High wind gusts exceeding 30 mph combined with highly saturated soil caused isolated cases of felled trees and power lines. Property damage estimates were around 2.5K.
February 4, 1998	Flood	A powerful nor'easter dropped between 2 and 4 inches of rain across Northern Virginia resulting in widespread minor to moderate flooding. Hundreds of roads were closed across the region. The dam at Lake Jackson was reported to be over 6 feet above flood stage. Several school districts closed for the following day due to the flooding and continued threat of heavy rain. Property damage estimates were 5K.
June 23, 1998	Flash Flood	A series of strong to severe thunderstorms in Northern and Central Virginia produced rainfall totals between 2 and 6 and wind gusts between 60 and 80 mph. Flooding of several low-lying areas occurred and streams in the area over spilled their banks. The storms knocked out power to at least 12,500 customers in Northern and Central Virginia.
September 16, 1999	Flash Flood	Storms from Hurricane Floyd produced rainfall totals just shy of 6 inches in Spotsylvania County. The same area observed wind gusts between 30 and 50 mph. Wind gusts caused several trees to fall down combined with high water forced the closure of several roads in the county.
September 3, 2000	Flash Flood	Heavy thunderstorms produced a total rainfall of 2.5 inches in only 50 minutes in Spotsylvania County Across the county Rtes. 17 and 1, Leavells Road, and Loreilla Park Drive were flooded and closed.
February 22, 2003	Flood	In Spotsylvania County a storm produced between 1.5 to 3 inches of rain combined with the snowmelt of a massive snowstorm led to widespread flooding across Northern Virginia. In Spotsylvania County, 1 primary and 7 secondary roads were flooded and 1 private road was washed out. County officials rescued 4 people, 2 horses, and six dogs from flood waters.
March 20, 2003	Flood	Across the region of Northern Virginia between 1.5 and 2.5 inches of rain fell. In Spotsylvania County, a handful of roads were caused by flooding.
September 18, 2003		
January 14, 2005	Flood	Flooding and a mudslide reported in Central Virginia.
June 26-27, 2006	Flash Flood	Persistent rain across a 5 day period resulted in double digit rainfall totals across Northern Virginia. There were extensive power outages across the region and the VRE was temporarily inoperable. Debris was reported over the road near Jefferson Davis High and Spotsylvania Parkway due to receded flood waters.

Date	Event	Comments
November 16, 2006	Flood	Thunderstorms hit Northern Virginia producing floods throughout the region. In Spotsylvania County, several trees were downed. School buses in the county were forced to return students to school due to flooding on county roadways between Massaponax Church and Leavells.
July 29, 2007	Flash Flood	A cold front combined with a low pressure system triggered thunderstorms across Central and Northern Virginia. Several of these storms were severe producing damaging winds and large hail. Law Enforcement officials in Spotsylvania County reported water over the road at Teton Drive and Landsdowne Road. A mudslide was reported on Route 1.
May 9, 2008	Flood	Numerous strong to sever thunderstorms struck the area of Central and Northern Virginia. Two tornadoes occurred in Central Virginia. These storms produced damaging winds that drowned trees and power lines. Spotsylvania County Emergency Management reported that West Catharpin Road in Logan was closed due to high water.
May 11, 2008	Flood	Thunderstorms in the Northern Virginia region produced strong gusty winds and heavy rains. Several trees and power lines fell across the region. Spotsylvania County Emergency Management reported numerous road closures due to flooding. Many of these roads remained closed through the following afternoon.
June 2, 2009	Flash Flood	Thunderstorms producing high amounts of heavy rainfall resulted in flooding in areas of Spotsylvania County. Water was flowing over Courthouse Road. Flooding at the intersection of West Catharpin and West Pamunkey roads caused their closures.
June 3, 2009	Flash Flood	Thunderstorms producing heavy rains led to flash flooding in Spotsylvania County. As a result, Brock Road near American Legion Road was closed.
September 30-October 1, 2010	Flash Flood	The remnants of Tropical Storm Nicole brought up to 5 inches of rain to the Northern Virginia region. Water had spilt over onto Route 17 in Spotsylvania County. A report on rainfall for the county claimed it had received near 5.5 inches. Elys Ford Road closed due to flash flooding conditions on the Rapidan River.
September 8, 2011	Flash Flood	Numerous roadways were closed in eastern Spotsylvania County. A sinkhole occurred near the intersection of Windsor Drive and Abbey Lane.
December 7, 2011	Flood	Route 3 was closed near Chancellor Village Lane due to high water. Partlow Road was closed due to high water. Portion of Catharpin Road was closed due to high water. Massoponax Church Road was closed near Mills Drive due to high water.
July 14, 2012	Flash Flood	A slow moving warm front was located across central Virginia. During the afternoon, showers and thunderstorms developed along and north of this feature. A very warm and moist atmosphere along with light winds throughout the atmosphere caused very high rainfall rates with slow storm motion. Flash flooding resulted. Flash flooding forced the closure of Lansdowne Road.

Date	Event	Comments
September 6, 2012	Flash Flood	There were portions of West Catharpin Road closed due to flash flooding on Catharpin Creek which resulted from heavy rains. Flash flooding was also reported on Jefferson Davis Hwy near Massaponax.
June 13, 2013	Flash Flood	Due to heavy rains, there was high water near the intersection of Leavells Road and Courthouse Road and the intersection of Courthouse Road and Jefferson Davis Highway.
April 30, 2014	Flood	The eastern half of the United States was under cyclonic flow and moisture from the Atlantic and Gulf continued to move into the Mid Atlantic. 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. Piedmont Drive was flooded and closed southwest of Fredericksburg.
February 24, 2016	Flash Flood	Salem Church Road was flooded and closed near Jackson Road.
June 28, 2016	Flash Flood	Deerfield Drive was flooded and closed between Buck Lane and Fawn Circle.

Source: NOAA, 2016.

Historic Hurricane Events – Spotsylvania County

Storm Name	Date	Category	Total Est. Damage	Descriptions
Hazel	October 15, 1954	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Connie	August 12, 1955	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Diane	August 17, 1955	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Camille	September 1960	Hurricane	Unknown	The Free-Lance Star reported massive flooding.
Floyd	September 16, 1999	Tropical Storm	No estimate available.	Gusty winds from 30 to 50 mph 16,000 power outages 5.97 inches in Spotsylvania In Spotsylvania County, several trees were downed and high water closed several roads in the eastern portion of the county.
Isabel	September 18, 2003	Tropical Storm	$55.1 million – property $130,000 – crop	85% of County was without power for up to 9 days
Charley And Bonnie	August 18, 2004	Hurricane	Unknown	Highest sustained wind was 73 mph Uprooted trees and downed numerous power lines Over 2 million Virginians without power Heavy rain and wind gust
Gaston	August 30, 2004	Tropical Depression	Unknown	Hard rains that processed flooding Roads under water Power outage (99,600 statewide)

Frances	September 8, 2004	Hurricane	Unknown	
Ivan	September 17, 2004	Hurricane	Unknown	Spawned unconfirmed tornadoes Power outage (66,000) Heavy rain/flooding
Jeanne	September 28, 2004	Hurricane	Unknown	Flash flooding/heavy rainfall Power outage
Irene	August 27, 2011	Tropical Storm	$10k	Downed trees were responsible for over 3,000 homes without power across the county.

Source: National Climatic Data Center 2016.

Historic Tornado Events – Spotsylvania County

Date	Magnitude	Property Damage ($)	Descriptions
February 18, 1960	F1	0K	
September 5, 1979	F1	250K	
1998	F1	NA	Local emergency management reports tornado activity along the Rt. 17 Bypass / CSX Railroad / Rt. 608 Benchmark Road. One home and one industrial building are damaged.
July 2, 1999	F1	10K	Parts of southern Spotsylvania County lost power after downed trees fell onto power lines Most of the downed trees were in the Falmouth area.
2000	F1	NA	Local emergency management reports tornado activity along Hickory Ridge Road destroying one single-wide trailer. The area impacted started behind Berkeley Elementary School continuing northeast to Rte. 1 and 608.
2002	F1	NA	Local emergency management reports tornado activity in the Paytes area. No building damage was reported.
July 10, 2003	F0	0K	F0 tornado touched down approximately 5 miles southeast of Falmouth near Route 3 The tornado moved northeast and damaged trees until it lifted near Route 218 on the Spotsylvania County line
May 7, 2004	F1	10K	At 7:51 p.m., an F1 tornado touched down near Shiloh. At least a dozen dwellings and 10 boats were damaged. Several trees were also uprooted or had their tops ripped out along the storm's three-mile path. In Stafford County, 80 to 90 mph winds destroyed two homes and caused major damage to 20 others. The Japazawas Subdivision in eastern Stafford County had approximately 40 trees down. Three Amtrak trains were stalled between the Chatham area of Stafford and Fredericksburg due to downed trees and power lines. In the County of Spotsylvania, the main stage at the re-enactment of the Battle of Spotsylvania collapsed due to strong winds. A number of tents and a couple of portable toilets were also blown over. Estimated damages were $10,000.

Date	Magnitude	Property Damage ($)	Descriptions
September 17, 2004	FO	500K	F0 tornado touched down approximately 5 miles southeast of Falmouth near Route 3 A thunderstorm moved from Spotsylvania County into the eastern portion of the City of Fredericksburg. No property damage was reported, with debris scattered along Dixon Street. At 4:29 p.m., emergency personnel witnessed a weak tornado in the New Crest Area that caused minor damage to homes and trees. At 5:05 p.m., a brief tornado touched down near Holladay. It was videotaped by a local fire fighter. No damage or injuries were reported.
May 11, 2006	F0	80K	A cold front, combined with a strong upper-level disturbance caused widespread severe thunderstorms. Tornado touched down near Mastins Corner and continued northeast. Damage path was about 5 miles long and 75 yards wide. Structural damage was noted, due to falling trees and limbs.
May 11, 2006	F0	35K	A cold front combined with a strong upper-level disturbance caused widespread severe thunderstorms. A small tornado formed from this storm, hitting the Fredericksburg Spotsylvania Military Park. All damage was to trees only.
June 14, 2013	EF0	$2k	After review of radar observations, spotter reports and a ground survey, the NWS has confirmed a EF-0 tornado in Spotsylvania County on the afternoon of Thursday, June 13, 2013. The tornado originally touched down near Jennings Pond in Central Spotsylvania County and then traveled Northeast across the county. Intermittent tree damage occurred along the path including along Robert E Lee Drive approximately one mile west of State HWY 208 in the Fredericksburg and Spotsylvania National Military Park and in the Three Cedars subdivision near Leavells Road.

Source: National Climatic Data Center and local emergency management; NA = Data not available.

Historic Northeaster and Winter Storm Events – Spotsylvania County

Date	Event	Rain Fall (in.)	Comments
December 28, 1993	Heavy Snow	0	
January 28, 1995	Heavy Snow	0	
January 9, 1996	Heavy Snow	0	Low and mid-level lift ahead of an "Alberta Clipper" added insult to injury only a day after the "Blizzard of '96", dumping 4 inches of snow in a 5 hour period near the tidal Potomac River.

Date	Event	Rain Fall (in.)	Comments
January 12, 1996	Heavy Snow	350K	Less than one week after the crippling "Blizzard of '96", a new winter storm dumped substantial snow across northern and western Virginia. In southern Stafford Co (VAZ055), a woman was injured when a carport collapsed. The snow changed to freezing rain and sleet along the tidal Potomac River shortly before tapering off. The changeover suppressed accumulations to 4 or 5 inches in this region. In other portions of northern Virginia, snowfall totals were as follows: in the piedmont, 5 to 7 inches; at higher elevations, 6 to 10 inches. In southern Stafford Co (VAZ055), a woman was injured when a carport collapsed. Luckily, she was protected from serious injury by the automobile, which had its windows shattered.
February 2, 1996	Heavy Snow	0	A vigorous upper level jet stream induced low-level lifting of warm moist air over a stationary arctic front extending from Tidewater Virginia through the Tennessee Valley early on the 2nd, producing a 75 mile-wide band of heavy snow which extended from the central piedmont through the Northern Neck region. The heaviest snows fell in a narrow band from northern Albemarle Co through King George Co. Accumulations in these areas ranged from 8 to 13 inches, and snowfall rates were as high as 3 inches per hour.
February 2, 1996	Heavy Snow	0	The continuation of a strong upper-level jet stream, combined with additional mid-level dynamics, generated surface low pressure over central Georgia by evening on the 2nd. As the low moved to near Cape Hatteras overnight, a broad area of heavy snow overspread all of northern Virginia. Areas that received 4 to 13 inches during an early morning event (on the 2nd) picked up an additional 4 to 6 inches, leaving most areas from the central piedmont through the northern neck with a grand total of 12 to 18 inches.
February 16, 1996	Heavy Snow	0	A strong "Alberta Clipper", diving southeast from the upper Midwest into the deep south, linked up with subtropical moisture lurking along the southeast U.S. coast to develop a classic nor'easter, which moved from northeast South Carolina to off the Virginia Capes during the day on the 16th. As the area of low pressure intensified, it wrapped Atlantic moisture well to the west, where modified arctic air was pouring in from southern Canada. The result was a thin band of heavy snow which extended from southwest Virginia through the upper eastern shore of Maryland.
February 8, 1997	Heavy Snow	25K	A winter storm dumped 4 to 8 inches of heavy, wet snow across all of northern and western Virginia on the 8th.
January 14, 1999	Winter Weather	0	A strong arctic cold front moved slowly southeast across the Mid-Atlantic region from late on the 13th to midday on the 15th. By 9am on the 15th, ice accumulations from one quarter to nearly one inch occurred north of a line from Augusta County to Spotsylvania County. The ice this storm left behind had a large impact on the region. Hundreds of car accidents, slip and fall injuries, downed trees, and power outages were reported. In Stafford County, a jackknifed tractor trailer closed State Route 3 and 621, and Interstate 95 had to be temporarily shut down to clear fallen trees. Over 215,000 customers lost power from the storm across Northern Virginia, and Central Virginia reported over 6,000 additional outages.

Date	Event	Rain Fall (in.)	Comments
March 9, 1999	Winter Storm	0	An area of low pressure moved from the Ohio Valley to North Carolina from late on the 8th through the evening of the 9th. Snowfall rates were in excess of 1 1/2 inches per hour in many locations during the storm. Stafford County received between 4 to 8 inches. Spotsylvania and King George County received between 2 and 6 inches. The city of Fredericksburg reported over 100 accidents. On Interstate 95 in Spotsylvania County, a woman was killed in a morning car accident.
January 20, 2000	Winter Weather	0	An area of low pressure moved from west to east across the Mid-Atlantic region on the 20th, dropping 2 to 6 inches of snow between midnight and mid-afternoon. Gusty winds of 35 to 45 MPH developed during the afternoon causing the snow to drift across roadways and reduce visibilities in open areas.
January 25, 2000	Northeaster	0	Low pressure off Cape Hatteras rapidly intensified late on the 24th and developed into a nor'easter which tracked northward along the Eastern Seaboard on the 25th. Very heavy snow and near-blizzard conditions were seen throughout the day east of the Blue Ridge Mountains, resulting in extremely hazardous travel conditions. Wind gusts of up to 45 MPH were recorded and several roads were drifted shut by blowing snow. The governor of Virginia declared a state of emergency as the storm battered the eastern part of the state.
January 30, 2000	Ice Storm	0	Cold air was in place east of the Blue Ridge Mountains on the 29th and 30th, keeping surface temperatures below freezing. Low pressure moved from the Lower Mississippi Valley northeastward to the Mid-Atlantic region early on the 30th, creating the perfect conditions for freezing rain around the Fredericksburg area, a mix of sleet and snow east of Skyline Drive, and moderate snowfall in the mountains. Ice accumulations between 1/4 and 3/4 of an inch coated roads, trees, and power lines in Fredericksburg and Stafford, Spotsylvania, and King George Counties. Electrical outages were reported as trees and branches weighed down by ice fell onto power lines. Disruptions affected 3000 customers in Fredericksburg and Spotsylvania and King George Counties.
February 12, 2000	Winter Weather	0	Low pressure moved from Tennessee to the North Carolina Coast on the 12th, spreading snow across the Central Shenandoah Valley and the Northern and Central Piedmont. Periods of light snow occurred from sunrise to late afternoon with accumulations ranging from 1 to 5 inches. A period of freezing drizzle also occurred around sunset.
December 13, 2000	Winter Weather	0	A strong cold front brought chilly air into the region on the 12th. By the afternoon of the 13th, an upper level disturbance brought warm air into the mid levels of the atmosphere and caused snow that fell from the system to melt to rain on its way down. When the rain hit the ground where temperatures were below freezing, ice accumulated.

Date	Event	Rain Fall (in.)	Comments
February 22, 2001	Winter Storm	0	This system produced mainly light to moderate snowfall across the region between 9 AM and 10 PM. Snowfall amounts ranged from 2 to 5 inches. A 50 vehicle crash occurred on the northbound lanes near Masaponax in Spotsylvania County. The accident occurred as motorists crested the top of a hill, hit near zero visibility, and slammed on their breaks. Three people were treated for serious injuries and another 18 suffered minor injuries. The highway remained closed for three hours while the wreckage was cleared. A 30 vehicle pileup occurred on the southbound lanes just north of the Falmouth/Route 17 interchange in Stafford County. As whiteout conditions struck, three cars slid into each other. Within seconds, the minor fender bender turned into a pileup including tractor trailers, cars, trucks, and an empty bus. Three people were injured and the highway was blocked for nearly three hours.
January 3, 2002	Winter Storm	0	Low pressure tracked across extreme southeast Virginia during the morning of the 3rd. This storm brought light to moderate snowfall to the Central Piedmont and Fredericksburg areas between 5 AM and 3 PM. In Stafford County, an inch of snow caused slippery roads and delayed school openings. In Spotsylvania and King George Counties, snowfall totals ranged from 3 to 5 inches.
January 19, 2002	Winter Weather	0	Low pressure that moved across North Carolina on the 19th brought mixed precipitation to the region between 6 AM and 11 PM. In most locations, the precipitation started off in the form of snow, and then changed to a mix of sleet and rain around midday.
December 5, 2002	Winter Storm	0	This storm produced accumulating snowfall across the entire region as it moved by. Across the Central Piedmont and Fredericksburg area, freezing rain and sleet was mixed in with the snow. The snow and sleet accumulations ranged from 4 to 6 inches in this area.
February 6, 2003	Winter Storm	0	Low pressure tracked from the Gulf Coast to the Carolinas on the 6th then off the Atlantic coast on the 7th. This storm dropped light to moderate snow between the evening of the 6th and Noon on the 7th. Accumulations ranged from 3 to 7 inches.
February 14, 2003	Winter Storm	8.9M	A complex storm system produced copious amounts of wintery precipitation across the northern third of Virginia between the evening of the 14th and midday on the 18th. After the precipitation came to an end, record breaking snow and sleet accumulations were reported.
February 26, 2003	Winter Weather/mix	0	A series of low pressure systems that tracked from the Gulf Coast to Cape Hatteras dropped light snow off and on between the morning of the 26th and midday on the 28th. A total of 5 to 8 inches of snow accumulated across the northern third of Virginia during the storm. Minor traffic accidents were reported after the fallen snow made roads slippery.
December 14, 2003	Winter Weather/mix	0	An area of low pressure developed over the Gulf Coast region and tracked northeast into the Mid Atlantic region. The storm produced a mixture of snow, sleet and freezing rain. Snowfall totals across Northeast Virginia averaged 3 to 4 inches.

Date	Event	Rain Fall (in.)	Comments
January 25, 2004	Winter Weather/mix	0	An area of low pressure developed off the coast of North Carolina and tracked north. This storm produced widespread snow, sleet and freezing drizzle over the region. Two to four inches of snow fell over the Central Foothills and the Northern Piedmont of Virginia. The snow mixed with sleet and finally changed over to freezing drizzle before tapering off. Several other minor accidents occurred according to Emergency Operations Centers. Dozens of school districts closed.
January 30, 2005	Winter Storm	0	A storm system brought a mix of snow, sleet, and freezing rain affecting most of Central Virginia. Freezing rain accumulated to around .25 inches resulting in hazardous driving conditions.
December 5, 2005	Heavy Snow	40K	A winter weather storm produced 4 to 6.5 inches of snow across Northern Virginia. There were reports of trees down in Spotsylvania County due to heavy snow accumulations.
February 11, 2006	Heavy Snow	250K	Storm snowfall across Northern Virginia produced between 8 and 14 inches. There were reports of isolated drifting of snow and downed powerlines throughout the region. This caused over 300,000 customers to be without power in the greater Washington/Baltimore area.
March 1, 2009	Winter Storm	0	A low pressure system produced storms releasing averaged snowfall totals of 5 inches across Spotsylvania County and the rest of Northern Virginia.
January 30, 2010	Winter Storm	0	Snowfall amounts between 5 and 6 inches were reported across Spotsylvania County.
February 16, 2010	Winter Storm	0	Snowfall totaled up to 1.5 inches in Chancellorsville in Spotsylvania County. There were several reports of accidents during rush hour near Fredericksburg and Chancellorsville.
December 16, 2010	Winter Storm	0	Snowfall was estimated around 4 inches in Spotsylvania County.
January 20, 2012	Winter Weather	0	Low pressure passed through the area during the evening of the 20th into the morning hours of the 21st. There was enough cold air for precipitation to start off as snow, but warmer air eventually wrapped into the system, causing precipitation to change to a wintry mix. Snow and sleet accumulations were estimated to be around an inch or less across the county. A glaze of ice accumulation from freezing rain was also estimated.
January 22, 2012	Winter Weather	0	Low pressure was located over the central portion of the nation while high pressure remained just off the New England Coast. Surface cold air remained in place during the evening hours of the 22nd into the morning hours of the 23rd. A southerly flow around the low allowed for warm and moist air to overrun the surface cold air, resulting in periods of freezing drizzle. Temperatures rose above freezing later during the morning hours of the 23rd.A light glaze of ice was estimated across the county.
February 19, 2012	Winter Weather	0	Low pressure passed by to the south while high pressure to north pumped in cold air. Precipitation associated with the low fell in the form of snow across central Virginia. Snowfall totaled up to 1.8 inches about three miles east of Dunavant.

Date	Event	Rain Fall (in.)	Comments
March 5, 2012	Winter Storm	0	A potent area of low pressure tracked through southern Virginia during the morning and early afternoon hours of the 5th. A band of precipitation developed on the northern side of the low. There was enough cold air for precipitation to fall in the form of snow, and the heaviest snow was across central Virginia. Snowfall totaled up to 5.0 inches at the Spotsylvania Courthouse.
January 23, 2013	Winter Weather	0	A positively tilted trough of low pressure moved through the Mid Atlantic while a weak clipper system moved through Central Virginia. Cold temperatures and banding produced advisory level snowfall accumulations. Snowfall amounts of around an inch were reported during the morning rush hour.
January 25, 2013	Winter Weather	0	An Alberta clipper moved through the Mid Atlantic producing light snow for most of the region. Dry air at the surface limited snowfall amounts for most of the area. Snowfall amounts of around one inch was reported at surrounding locations during the evening rush hour.
February 1, 2013	Winter Weather	0	A clipper system moved through the Mid Atlantic in the early morning hours and produced advisory level snowfall in the Baltimore and Washington DC metro areas. Snowfall amounts of around an inch were reported at surrounding locations during the morning rush hour.
March 5, 2013	Winter Storm	0	Strong low pressure impacted the Mid Atlantic bringing rain and snow to the region. A rain-snow line was present across the I-95 corridor where snowfall accumulations dropped off significantly from west to east. Snowfall amounts of 8 inches were reported at Dunavant.
March 17, 2013	Winter Weather	0	Low pressure developed along a stationary front south of the Washington DC. Surface temperatures were marginal and snowfall accumulated west of the I-95 corridor. A cold air damming situation formed during the event and led to accumulating snow across the Shenandoah Valley and Central Foothills. Snowfall totaled up to around one inch near White Oak and Spotsylvania.
March 24, 2013	Winter Weather	0	Coastal low pressure impacted the Mid-Atlantic region with snow and rain showers. Surface temperatures were marginal during the event and a sharp gradient of snowfall accumulation existed near Washington DC. Snowfall totaled up to 4.2 inches about ten miles west of Fredericksburg.
December 8, 2013	Winter Weather	0	Ice accumulations of around a tenth of an inch fell at surrounding locations.
January 2, 2014	Winter Weather	0	Low pressure tracked across the Mid Atlantic and led to accumulating snow with the highest amounts from Northern Virginia to East-Central Maryland. Low pressure quickly moved off the coast. Snow accumulations of two inches or more were measured at surrounding locations.
January 10, 2014	Winter Weather	0	A weak disturbance crossed the Mid Atlantic while a wedge of high pressure was at the surface. Precipitation that fell melted aloft and froze on contact. Ice accumulations of a trace or more were measured at surrounding locations.
January 21, 2014	Winter Weather	0	A shortwave trough moved into the region while low pressure developed south of the Mid Atlantic. Upper level dynamics led to moderate to heavy snow to move into the region. Snow accumulations of two inches or more were measured at surrounding locations.
January 28, 2014	Winter Weather	0	Snow accumulations of two inches were measured at surrounding locations.
February 4, 2014	Winter Weather	0	Ice accumulation of a trace or more was reported at surrounding locations.

Date	Event	Rain Fall (in.)	Comments
February 12, 2014	Winter Storm	0	Low pressure moved up the east coast and approached the Mid Atlantic. High pressure was located across New England and fed cold air into the region. Heavy snow fell across most parts of the Mid Atlantic with the highest amounts near the Mason Dixon line where mid level forcing led to a heavy band. Snow accumulations of 6 or more inches were measured at White Oak.
March 3, 2014	Winter Storm	0	A cold front crossed the region as low pressure passed across the south of the Mid Atlantic and heavy snow moved across the region. Temperatures dropped from north to south and precipitation changed from rain to sleet/freezing rain to snow. Snow accumulations of five or more inches was measured at Spotsylvania.
March 7, 2014	Winter Weather	0	Ice accumulation of a trace was reported at Spotsylvania.
March 16, 2014	Winter Storm	0	Two areas of low pressure formed south of the Mid Atlantic. Dry and cold air at the surface led to precipitation to quickly change to snow. Heavy snow fell across the region with a confined area of greater than 10 inches across the Central Foothills. Snow accumulation of five or more inches was measured at Fredericksburg.
March 18, 2014	Winter Weather	0	A wedge of high pressure was across the Mid Atlantic. Low level moisture and sub freezing temperatures led to freezing drizzle and freezing rain across the Central Foothills, Shenandoah Valley, Piedmont and Southern Maryland. Ice accumulation of a trace was reported at surrounding locations.
March 25, 2014	Winter Weather	0	Snow accumulation of 2 inches or more was measured at surrounding locations.
February 16, 2015	Winter Storm	0	A surface low formed over Texas, then quickly moved east during the day and overnight, pushing off the Carolina coast by the morning of the 17th. A very cold airmass in place from retreating Arctic high pressure resulted in higher than average snow ratios, between 12:1 and 15:1. Central Virginia received the highest amounts, with lower amounts to the north and west. Between 5.0 and 8.5 inches was reported by multiple sources in the county and surrounding areas.
February 21, 2015	Winter Weather	0	Low pressure lifting from the Ohio River Valley into the eastern Great Lakes dragged a cold front through the region. Southerly flow ahead of the front resulted in high moisture advection and with temperatures hovering in the 20s, moderate to heavy snow was reported across the region. Snow totals between 2.0 and 3.0 inches was reported. Ice totals between a trace and 0.05 inches was reported.
February 25, 2015	Winter Weather	0	Low pressure passing to the south brought widespread snow. Between 2-2.5 inches reported.
March 1, 2015	Winter Weather	0	Storm total ice between 0.10 and 0.20 inches was reported around the county.
March 5, 2015	Winter Storm	0	A cold front brought widespread heavy snow to the area with a strong convergence zone aligning across northern Virginia into eastern Maryland resulting in mesoscale banding and higher snow totals. Storm total snow between 5.0 and 7.0 inches was reported around the county and in surrounding areas.
January 20, 2016	Winter Weather	0	A shortwave trough swung through the Mid-Atlantic during the later afternoon and evening hours. A quick burst of snow occurred during the peak of rush hour and with below freezing temperatures already place, led to accumulations of up to one inch. Hundreds of traffic incidents were reported with icy conditions forming on the roadways. Spotters reported around half of an inch across the county.

Date	Event	Rain Fall (in.)	Comments
January 22, 2016	Winter Storm	0	Coastal low pressure rapidly intensified as it tracked up the Mid-Atlantic coast. At the same time, high pressure to the north was funneling cold air into the region. The strong low pressure system was able to tap into moisture from the Gulf of Mexico and the Atlantic Ocean resulting in heavy amounts of precipitation. The cold air caused that precipitation to fall in the form of snow. Gusty winds also accompanied this storm. The combination of gusty winds and low visibility along with snow and blowing snow caused blizzard conditions across portions of northern Virginia. Snowfall amounts between 17 and 24 inches were reported across Spotsylvania County.
February 14, 2016	Winter Storm	0	Prolonged event impacted the Mid-Atlantic. Southwest flow aloft overriding northeast flow at the surface from departing high pressure led to snow spreading over the region initially. Low pressure formed and organized over the Gulf of Mexico, eventually pushing off to the northeast and impacting the region on the 15th. As the cold air wedge was eroded away from this low, warming at all levels led to the snow transitioning to sleet and ice for most of the area. Between 5 and 8 inches of snow was reported.

Source: National Climatic Data Center, 2016.

4.3.5 - Stafford County Hazard Identification

For the 2017 plan update, the committee reviewed the Commonwealth of Virginia Hazard Mitigation Plan, as well as hazard events over the preceding five years, to determine the relative risk and priority (high, medium, or low) of various hazards as they specifically affect the locality. These hazards and their local priorities are presented in the chart below. For hazards that ranked high and medium-high were then investigated further and a specific vulnerability analysis was performed.

Hazard Priority – Stafford County

Identified Hazards	Local Hazard Priority
Dam Failure	Low
Drought and Extreme Heat	Medium-High
Wildfires	Medium-High
Earthquakes	Low
Sinkholes and Landslides	Medium-Low
Flooding and Erosion	High
Non-Rotational Wind	High
Tornadoes	High
Winter Storms and Nor'easters	High

Flooding

Flooding in Stafford County can occur at any time throughout the year but is more frequent during the fall and spring. The most severe flooding events have been associated with intense rainfall from hurricanes and tropical storms. The plan update process has identified past flood events that are listed in the table below. There have been 33 flooding events in Stafford County since 1993. With an average of 1.43 floods per year, the probability of future occurrences is rated as high.

Noted Problem Areas

Local representatives and past planning efforts have noted several areas within the community that are affected by frequent flooding. These include:

- Repeated road closures due to flooding and debris at:
  - River Road;
  - Vista Woods, Grafton Village, and Argyle Hills;
  - Harrell Road at the CSX Crossing; and
  - Aquia Drive, requiring emergency access from Decatur Road.
- Riverine flooding in several neighborhoods including:
  - The Falmouth area, which is often evacuated; and
  - The Aquia Harbour area with over 1000 homes affected.
- Tidal flooding at the marina area.

The probability of future occurrences is ranked as high. A 100-year event has a one percent probability of occurring in any given year. The 100-year floodplains for Stafford County have been identified.

Wildfires

In evaluating the localized threat of wildfires to Stafford County, data from the Virginia Department of Forestry was used to identify incidents of wildfires that may have posed a threat to the community. Fires were most common in Stafford County from the month of February until April. The past occurrences are presented in the table below. Since 1995 there have been 79 incidents of wildfire, or an average of 3.76 fires per year. Therefore, the probability of future occurrences is rated as medium-high.

Non-Rotational Wind (Hurricanes and Thunderstorms)

In evaluating the localized threat of hurricanes to Stafford County, NOAA hurricane track data was used to identify storms that may have posed a threat to the community. The analysis included hurricanes, tropical storms, tropical depressions, and extratropical storms which passed through the region and affected the local community. These past occurrences are presented in the following table. Locally, hurricanes have caused:

- Heavy rain;
- Gusty and high sustained winds;
- Flooding and property damage;
- Road closures; and
- Multiple power outages.

The probability of future occurrences is ranked as medium. With 12 hurricanes occurring between 1954 and 2016, Stafford County experiences approximately 0.19 hurricanes per year.

Tornadoes

In evaluating the localized threat of tornadoes to Stafford County, NOAA severe weather data was used to identify storms that may have posed a threat to the community. Most tornado activity occurred from

May to September. These past occurrences are presented in the tale below. Locally, tornadoes have caused:

- Property damage, including the displacement of boats in dry dock;
- Tree damage and resultant power outages.

The probability of future occurrences is ranked as medium. With 13 tornadoes occurring between 1960 and 2016, Stafford County experiences approximately 0.23 tornadoes per year.

Winter Storms

In evaluating the localized threat of winter storms to Stafford County, NOAA severe weather data was used to identify storms that may have posed a threat to the community. These past occurrences are presented in the table below. Locally, the winter storms have caused:

- Excessive snow, sleet, and freezing rain;
- Multiple traffic accidents (noted incident on Route 17) and delays;
- Tree and property damage;
- Power outages; and
- Injury and loss of life.

A noted winter weather event during 2002 resulted in a traffic accident involving over 100 vehicles on southbound interstate 95 due to icy and white-out conditions. The interstate was closed for several hours. Additional traffic accidents during the 2004 winter season resulted in the death of 3 teenagers, in separate accidents, due to wet or icy road conditions.

The probability of future occurrences is ranked as medium. With 67 events occurring between 1993 and 2016, Stafford County experiences approximately 2.91 winter events per year.

Historic Flood Events – Stafford County

Date	Event	Comments
March 4, 1993	Flood/Flash Flood	Moderate to heavy rain inflicted the region of Northern Virginia dumping 1 to 4 inches of rain, leading to widespread flooding. Several roads were closed and cars were damaged trying to traverse flooded sections of roads. Excessive rainfall and runoff caused several rivers of the Shenandoah Valley to flood as well.
January 19-22, 1996	Flood	River flooding occurred across the Commonwealth of Virginia starting in the early morning of January 19th. Snowmelt with a liquid equivalency of 2 to 3 inches combined with another 1 to 3 inches of rainfall caused the worst regional flooding in over a decade. River flooding began at the headwaters of all basins, continuing downstream for the next 3 days. Crests ranged from 3 to 21 feet above the flood stage. High water caused millions in damages, closed roads, destroyed homes and businesses, and even forced the evacuation of several towns. Total property damage estimates were at 15 million and crop damages were at 81K.

Date	Event	Comments
July 14, 1996	Flash Flood	A severe thunderstorm in Stafford County produced heavy rainfall resulting in the flooding of several roads including sections of Rt. 1, Plantation Drive, and several side streets.
September 8, 1996	Flash Flood	A slow-moving thunderstorm caused substantial local flooding in Stafford County. Federal highway 1 was flooded at Boswell's Corner. Automobiles reported flooding, and evacuations were required into the Potomac Hills. Total property damage estimates were 40K.
January 28, 1998	Flood	A nor'easter lingering in the area produced heavy rains across the central and northeastern regions of Virginia. Widespread minor to moderate flooding of small streams, creeks, and low-lying areas occurred across the Northern Neck of Virginia. The Virginia Department of Transportation reported over 150 roads closed in the area due to standing water or creeks that exceeded bank full. High wind gusts exceeding 30 mph combined with highly saturated soil caused isolated cases of felled trees and power lines.
February 4, 1998	Flood	A powerful nor'easter dropped between 2 and 4 inches of rain across Northern Virginia resulting in widespread minor to moderate flooding. Hundreds of roads were closed across the region. The dam at Lake Jackson was reported to be over 6 feet above flood stage. Several school districts closed for the following day due to the flooding and continued threat of heavy rain. Property damage estimates were 10K.
September 16, 1999	Flash	Storms from Hurricane Floyd produced rainfall totals between 2 and 4 inches in Stafford County. The same area observed wind gusts between 30 and 50 mph. Wind gusts caused several trees to fall down combined with high water forced the closure of several roads in the county There were reports of over 16,000 power outages across the region of Northern Virginia.
September 3, 2000	Flash Flood	Thunderstorms with heavy rainfall brought a couple inches of rain leading to flash flood incidents in Stafford County. Stafford County Officials received reports of road flooding across the southern portion of the county. A vehicle in Falmouth was damaged by flood waters.
June 13, 2002	Flash Flood	Scattered thunderstorms with high wind and heavy rainfall produced flash flood conditions throughout Northern Virginia. In the northern portion of Stafford County, powerful winds knocked down trees and power lines onto Rtes. 610, 643, 628, and 630. Wind gusts of 54mph were recorded resulting in a chimney being knocked down. Up to 1.5 feet of water covered the intersection of Route 610 and Route 1.
February 22, 2003	Flood	In Stafford County a storm produced between 1.5 to 3 inches of rain combined with the snowmelt of a massive snowstorm led to widespread flooding across Northern Virginia. Red Fern Lane in Stafford County was flooded along with four other secondary roads. Total damage estimates were 100K.

Date	Event	Comments
March 20, 2003	Flood	Across the region of Northern Virginia between 1.5 and 2.5 inches of rain fell. In Stafford County, many secondary roads were underwater.
May 15, 2003	Flood	A series of thunderstorms struck the region of Northern Virginia producing between 2 and 4 inches of rain. Several road closures in Stafford County were reported due to flooding.
June 14, 2003	Flash Flood	Scattered thunderstorms with high winds and heavy rains moved through Northern Virginia that afternoon. Stafford County rainfalls exceeding 2 inches resulting in flooding in the northern portion of the county. Route 1, Decatur Road, and Mountain View Road were partially closed due to flooding.
July 10, 2003	Flash Flood	Thunderstorms with high winds, frequent lightning, hail, heavy downpours, and isolated tornadoes moved through Northeast Virginia that evening. Up to 3 inches of rain caused several roads to flood including southbound I-95. Trees and power lines were felled as well. An F0 and F1 tornado both touched ground in Stafford County.
December 10, 2003	Flood	A thunderstorm producing heavy rainfall of 2 inches combined with melting snow produced widespread road flooding across areas of Northern Virginia. Several rivers and creeks flooded as well.
January 14, 2005	Flood	Flooding and a mudslide reported.
April 2, 2005	Flood	A cold front brought severe thunderstorms that downed trees and power lines as well as heavy downpours that flooded rivers, streams, and roadways across Northern Virginia.
July 13, 2005	Flash Flood	A mudslide was reported along US Highway 15 and Butler road in Stafford County.
October 8, 2005	Flood	The remnants of Tropical Storm Tammy caused widespread heavy rainfall between 3 to 7 inches across the region of Northern Virginia. Widespread areal flooding resulted from slow water rises. Dozens of roads were flooded and closed due to high water including Route 1 and Mountain View Road in Stafford County.
November 16, 2006	Flood	Thunderstorms hit Northern Virginia producing floods throughout the region. In Stafford County, several trees were downed. Flooding was reported at Boswell's at the corner of US1 in North Stafford.
March 5, 2008	Flash Flood	A strong cold front brought strong to sever thunderstorms with gusty winds and heavy rain to the region. Heavy rain led to several road closures due to flooding. Wind gusts of 50 to 74 mph led to several reports of downed trees and power lines. Stafford County Emergency Management reported flash flooding along the creeks running into the Rappahannock River. A water rescue was performed in Falmouth.
May 9, 2008	Flood	Numerous strong to severe thunderstorms producing flooding occurred in Northern Virginia. Stafford County Fire and Rescue Department reported numerous road closures in Stafford County, mostly in the White Oak area. Closures included Jefferson Davis Highway in front of the Fire Department, Mount Olive Road, Kellogg Road, and Holy Corner Road.

Date	Event	Comments
May 11, 2008	Flood	Thunderstorms in the Northern Virginia region produced strong gusty winds and heavy rains. Several trees and power lines fell across the region. Stafford County Emergency Management reported numerous roads flooded in Stafford County.
September 6, 2008	Flash Flood	Tropical Storm Hanna produced thunderstorms which dropped 4 to 8 inches of rain and heavy wind gusts across the region of Northern Virginia. This precipitation produced flash flooding leading to dozens of road closures throughout Stafford County. There were several instances of downed trees and power lines also.
September 30, 2008	Flash Flood	A storm system originating from the Caribbean dropped between 4.5 and 6.5 inches of rain to parts of Northern Virginia. There were several reports of flash flooding in Stafford County leading to hundreds of road closures including Harrel Road, Ruffian Drive at Riva Ridge Road, Jefferson Davis Highway at several locations, Route 607 at Falmouth, Ingleside Drive and River Road.
August 27, 2011	Flash Flood	Harrell Road was closed between Forbes Street and Deacon Road due to flash flooding from Claiborne Run. A nearby rain gauge totaled 2.40 inches.
September 6, 2011	Flash Flood	Harrell Road was closed at Deacon Road due to flash flooding. A nearby rain gauge measured 2.10 inches.
September 8, 2011	Flash Flood	River Road was closed due to flash flooding.
December 7, 2011	Flash Flood	Brooke Road was closed due to high water. A rain gauge near Stafford recorded 3.58 inches.
April 30, 2014	Flood	Mine Road was flooded and closed south of Garrisonville.
August 18, 2014	Flood	Brooke Road was closed due to high water.
June 27, 2015	Flash Flood	Heavy rains resulted in several road closures: intersection of Cambridge; River Road; intersection of Brooke Road and Eskimo Hill Road; intersection of Princess Street and Kelly Way; intersection of Naomi Road and Jett Drive; and Amherst Avenue.
February 24, 2016	Flood	Harell Road and Austin Run Boulevard at Jefferson Davis Highway were closed at Forbes Street due to high water.

Source: National Climatic Data Center, 2016.

Historic Wildfire Events - Stafford County

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
03/25/1995	2	500	260,000	Campfire
03/27/1995	1	200	0	Children
04/01/1995	3	500	0	Children
04/04/1995	3	1,200	205,000	Miscellaneous
04/07/1995	3	500	200,000	Children
04/09/1995	1	500	46,000	Smoking
04/22/1995	3	0	0	Miscellaneous
04/24/1995	1	0	0	Children
03/06/1996	1	0	36,000	Miscellaneous

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
03/16/1996	2	0	7,500	Debris Burning
04/17/1996	2	0	0	Incendiary
04/17/1996	1	0	0	Incendiary
04/23/1996	1	0	250,000	Smoking
03/16/1997	2	0	0	Children
03/22/1997	1	0	0	Miscellaneous
03/24/1997	1	100	0	Debris Burning
04/02/1997	1	100	0	Debris Burning
03/28/1998	2	0	0	Children
03/31/1998	3	500	0	Debris Burning
03/31/1998	1	0	0	Miscellaneous
03/31/1998	1	100	0	Debris Burning
04/02/1998	3	200	0	Children
04/02/1998	3	300	95,000	Debris Burning
04/02/1998	2	0	0	Debris Burning
04/05/1998	1	0	0	Miscellaneous
04/06/1998	7	0	0	Smoking
04/06/1998	1	0	0	Children
04/13/1998	5	0	0	Children
10/29/1998	5	500	0	Smoking
10/30/1998	1	500	500,000	Debris Burning
12/30/1998	1	0	0	Children
03/20/1999	1	0	0	Children
03/29/1999	1	0	0	Miscellaneous
03/30/1999	4	0	0	Miscellaneous
03/31/1999	1	500	100,000	Debris Burning
04/06/1999	3	1,000	0	Children
04/06/1999	2	1,200	200,000	Children
04/08/1999	5	1,500	1,518,000	Children
04/08/1999	1	100	0	Children
04/08/1999	1	200	2,250,000	Children
04/14/1999	2	0	0	Children
04/14/1999	1	0	0	Smoking
03/06/2000	2	500	201,000	Children
04/10/2000	1	0	0	Children
11/01/2000	3	3,000	0	Smoking
05/01/2001	7	0	0	Campfire
11/07/2001	1	2,500	340,000	Smoking
11/12/2001	4	300	305,000	Children
11/12/2001	3	20,300	2000	Miscellaneous
11/26/2001	3	500	0	Smoking
02/26/2002	0.2	0	0	Incendiary

Date Put Out	Total Acres Burned	Total Damages ($)	Total Cost Saved ($)	Cause
02/26/2002	4	0	0	Fishermen
02/26/2002	0.1	0	0	Debris Burning—Urban Burner
03/01/2002	0.2	0	1,200,000	Incendiary—Juvenile
03/07/2002	5	5,000	2,000,000	Railroad
03/24/2002	2	100	0	Children—Juvenile
04/06/2002	4	200	0	Smoking
05/16/2002	1	300	0	Incendiary
07/18/2002	1	0	0	Children—Juvenile
08/12/2002	1	100	960,000	Children—Juvenile
12/02/2002	8	0	0	Equipment Use—ATV
03/15/2004	1	0	0	Children—Juvenile
04/19/2004	1	0	0	Children—Juvenile
04/19/2004	8	0	0	Debris Burning—Rural Burner
03/17/2005	2	0	0	Children—Juvenile
06/28/2005	4	1,000	600,000	Debris Burning—Rural Burner
11/13/2005	1	0	0	Children—Juvenile
02/25/2006	2	0	0	Children—Juvenile
02/27/2006	7	0	0	Debris Burning—Rural Burner
03/02/2006	3	0	0	Incendiary—Mental Cases
03/05/2006	3	0	0	Children—Juvenile
03/14/2007	0.3	0	0	Debris Burning—Rural Burner
03/03/2008	24	0	271,000	Children—Juvenile
03/25/2008	1	0	500,000	Debris Burning—Rural Burner
02/18/2011	6	0	1,610,000	Debris Burning
04/25/2011		3,000	0	Miscellaneous
02/7/2015	1.5	2,000	7,500	Children
04/5/2015	7.6	0	836,000	Debris Burning
04/5/2015	33	0	182,000	Equipment Use
03/23/2016	6.6	1,000	25,000	Debris Burning

Source: Virginia Department of Forestry, 2016.

Historic Hurricane Events – Stafford County

Storm Name	Date	Category	Total Est. Damage	Descriptions
Hazel	October 15, 1954	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Connie	August 12, 1955	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.

Storm Name	Date	Category	Total Est. Damage	Descriptions
Diane	August 17, 1955	Hurricane	Unknown	The Free-Lance Star reported flooding and property damage.
Camille	September 1960	Hurricane	Unknown	The Free-Lance Star reported massive flooding.
Floyd	September 16, 1999	Tropical Storm	No estimate available.	Gusty winds from 30 to 50 mph 16,000 power outages 5.97 inches in Spotsylvania
Isabel	September 18, 2003	Tropical Storm	$55.1 million – property $130,000 – crop	
Charley And Bonnie	August 18, 2004	Hurricane	Unknown	Highest sustained wind was 73 mph Uprooted trees and downed numerous power lines Over 2 million Virginians without power Heavy rain and wind gust
Gaston	August 30, 2004	Tropical Depression	Unknown	Hard rains that processed flooding Roads under water Power outage (99,600 statewide)
Frances	September 8, 2004	Hurricane	Unknown	
Ivan	September 17, 2004	Hurricane	Unknown	Spawned unconfirmed tornadoes Power outage (66,000) Heavy rain/flooding
Jeanne	September 28, 2004	Hurricane	Unknown	Flash flooding/heavy rainfall Power outage
Irene	August 27, 2011	Tropical Storm	100K	Numerous trees and power poles were down. Minor damage was reported to a few facilities. Several roads were closed due to fallen trees. US Route 1 and VA Route 654 were closed due to power lines down across the roadway. Approximately 8000 people were without power.

Source: NOAA 2016, VWC 2004, and local emergency management.

Historic Tornado Events – Stafford County

Date	Magnitude	Property Damage ($)	Descriptions
February 18, 1960	F1	0K	
September 5, 1979	F1	250K	
July 24, 1999	F1	10K	Parts of southern Stafford County lost power after downed trees fell onto power lines Most of the downed trees were in the Falmouth area.

Date	Magnitude	Property Damage ($)	Descriptions
September 24, 2001	F0	0.1K	At 4:00 p.m., the thunderstorm that produced the tornado near Sealston in King George County crossed into east Stafford County. A brief touch down occurred near Belle Plain. Minor tree damage was noted and later the same tornado briefly touched down near Aquia Bay Marina at the end of Aquia Creek Road, displacing three boats in dry dock. Damage was estimated at $10,000. At 4:18 p.m., an F0 tornado touched down in north Stafford County near Boswells Corner. Initially, the storm produced minor damage to trees, and siding and shingles were torn from a few homes. Minutes later, the storm produced extensive tree damage to the Crystal Lakes neighborhood. Damage was estimated at $50,000.
July 10, 2003	F0	0K	In Stafford County, an F0 tornado touched down approximately 5 miles southeast of Falmouth near Route 3. The tornado moved northeast and damaged trees until it lifted near Route 218 on the King George County line. The tornado was approximately 50 yards wide and was on the ground for 5 miles.
September 8, 2004	F0	10K	The thunderstorm which produced the tornado near Sealston in King George County continued into east Stafford County. A brief touch down occurred near Belle Plain (almost 4 miles NE of White Oak). Minor tree damage was noted and later the same tornado cycled and another brief touch down occurred near Aquia Bay Marina at the end of Aquia Creek Road (approximately 5 miles S of Aquia). Minor tree damage was noted there and 3 boats in dry dock were displaced. Power outage for several days.
September 17, 2004	F1	10K	At 4:42 p.m., a tornado touched down in central Stafford County near Stones Corner. The storm tracked north-northeast and lifted near Stafford. The damage was limited to mature trees and large limbs. The tornado had a six-mile intermittent track, continuing into Prince William County. Damage was estimated at $10,000. Tree damage to homes. Wind damage to a trailer park in Wildwater/Boswells Corner area.
May 11, 2006	F0	25K	A thunderstorm produced a tornado near Falmouth in Stafford County. The tornado caused noticeable tree damage on both sides of Interstate 95 near the Rte. 17 interchange.
May 8, 2008	F2	10.0M	The National Weather Service determined that a low-end F2 tornado struck the England Run North subdivision in Berea in Stafford County. There were 160 homes damaged and nearly destroyed within that subdivision. 25 of those were categorized as uninhabitable.
June 4, 2008	F1	25K	The National Weather Service announced that an F1 tornado touched down in southern Fauquier County travelling 10 miles into Stafford County. Mainly tree damage was observed.
June 4, 2008	F1	20K	An F1 tornado touched down in southern Stafford County 3 miles south of Ramouth. Maximum winds were estimated at 95 mph. Mainly tree damage was observed.
April 27, 2011	EF0	Unknown	A tornado was observed by a weather observer at Quantico and it was also seen by several others at a distance. Debris was reportedly lofted and circulated beneath a pendant funnel until it dissipated. The tornado was located in remote wooded portions of the Quantico Marine Corps Base so damage indicators were inaccessible. The tornado path continued into Prince William County.

Date	Magnitude	Property Damage ($)	Descriptions
October 13, 2011	EF0	20K	A warm front passed through central and northern Virginia during the afternoon and evening hours of the 13th. A potent upper-level trough approached the area during the same time causing strong winds aloft. Thunderstorms that developed behind the front were able to produce damaging wind gusts due to the strong winds aloft. Winds rapidly changed in both direction and speed with height causing some of the stronger thunderstorms to produce tornadoes near the warm front. About a dozen trees were sporadically uprooted and snapped. Homes in the community off Merryview Drive had minor roofing and siding damage. A chained link fence was also downed and a billboard was pushed nearly over.

Source: National Climatic Data Center 2016 and local emergency management; NA = Data not available.

Historic Northeaster and Winter Storm Events – Stafford County

Date	Event	Property Damage ($)	Comments
December 28, 1993	Heavy Snow	0	
January 28, 1995	Heavy Snow	0	
January 9, 1996	Heavy Snow	0	Low and mid-level lift ahead of an "Alberta Clipper" added insult to injury only a day after the "Blizzard of '96", dumping 4 inches of snow in a 5 hour period near the tidal Potomac River.
January 12, 1996	Heavy Snow	350K	Less than one week after the crippling "Blizzard of '96", a new winter storm dumped substantial snow across northern and western Virginia. In southern Stafford Co (VAZ055), a woman was injured when a carport collapsed. The snow changed to freezing rain and sleet along the tidal Potomac River shortly before tapering off. The changeover suppressed accumulations to 4 or 5 inches in this region. In other portions of northern Virginia, snowfall totals were as follows: in the piedmont, 5 to 7 inches; at higher elevations, 6 to 10 inches. In southern Stafford Co (VAZ055), a woman was injured when a carport collapsed. Luckily, she was protected from serious injury by the automobile, which had its windows shattered.
February 2, 1996	Heavy Snow	0	A vigorous upper level jet stream induced low-level lifting of warm moist air over a stationary arctic front extending from Tidewater Virginia through the Tennessee Valley early on the 2nd, producing a 75 mile-wide band of heavy snow which extended from the central piedmont through the Northern Neck region. The heaviest snows fell in a narrow band from northern Albemarle Co through King George Co. Accumulations in these areas ranged from 8 to 13 inches, and snowfall rates were as high as 3 inches per hour.
February 2,	Heavy Snow	0	The continuation of a strong upper-level jet stream, combined

Date	Event	Property Damage ($)	Comments
1996			with additional mid-level dynamics, generated surface low pressure over central Georgia by evening on the 2nd. As the low moved to near Cape Hatteras overnight, a broad area of heavy snow overspread all of northern Virginia. Areas that received 4 to 13 inches during an early morning event (on the 2nd) picked up an additional 4 to 6 inches, leaving most areas from the central piedmont through the northern neck with a grand total of 12 to 18 inches.
February 16, 1996	Heavy Snow	0	A strong "Alberta Clipper", diving southeast from the upper Midwest into the deep south, linked up with subtropical moisture lurking along the southeast U.S. coast to develop a classic nor'easter, which moved from northeast South Carolina to off the Virginia Capes during the day on the 16th. As the area of low pressure intensified, it wrapped Atlantic moisture well to the west, where modified arctic air was pouring in from southern Canada. The result was a thin band of heavy snow which extended from southwest Virginia through the upper eastern shore of Maryland.
February 8, 1997	Heavy Snow	25K	A winter storm dumped 4 to 8 inches of heavy, wet snow across all of northern and western Virginia on the 8th.
January 14, 1999	Winter Weather	0	A strong arctic cold front moved slowly southeast across the Mid-Atlantic region from late on the 13th to midday on the 15th. By 9am on the 15th, ice accumulations from one quarter to nearly one inch occurred north of a line from Augusta County to Spotsylvania County. The ice this storm left behind had a large impact on the region. Hundreds of car accidents, slip and fall injuries, downed trees, and power outages were reported. In Stafford County, a jackknifed tractor trailer closed State Route 3 and 621, and Interstate 95 had to be temporarily shut down to clear fallen trees. Over 215,000 customers lost power from the storm across Northern Virginia, and Central Virginia reported over 6,000 additional outages.
March 9, 1999	Winter Storm	0	An area of low pressure moved from the Ohio Valley to North Carolina from late on the 8th through the evening of the 9th. Snowfall rates were in excess of 1 1/2 inches per hour in many locations during the storm. Stafford County received between 4 to 8 inches. Spotsylvania and King George County received between 2 and 6 inches. The city of Fredericksburg reported over 100 accidents. On Interstate 95 in Spotsylvania County, a woman was killed in a morning car accident.
January 20, 2000	Winter Weather	0	An area of low pressure moved from west to east across the Mid-Atlantic region on the 20th, dropping 2 to 6 inches of snow between midnight and mid-afternoon. Gusty winds of 35 to 45 MPH developed during the afternoon causing the snow to drift across roadways and reduce visibilities in open areas.

Date	Event	Property Damage ($)	Comments
January 25, 2000	Northeaster	0	Low pressure off Cape Hatteras rapidly intensified late on the 24th and developed into a nor'easter which tracked northward along the Eastern Seaboard on the 25th. Very heavy snow and near-blizzard conditions were seen throughout the day east of the Blue Ridge Mountains, resulting in extremely hazardous travel conditions. Wind gusts of up to 45 MPH were recorded and several roads were drifted shut by blowing snow. The governor of Virginia declared a state of emergency as the storm battered the eastern part of the state.
January 30, 2000	Ice Storm	0	Cold air was in place east of the Blue Ridge Mountains on the 29th and 30th, keeping surface temperatures below freezing. Low pressure moved from the Lower Mississippi Valley northeastward to the Mid-Atlantic region early on the 30th, creating the perfect conditions for freezing rain around the Fredericksburg area, a mix of sleet and snow east of Skyline Drive, and moderate snowfall in the mountains. Ice accumulations between 1/4 and 3/4 of an inch coated roads, trees, and power lines in Fredericksburg and Stafford, Spotsylvania, and King George Counties. Electrical outages were reported as trees and branches weighed down by ice fell onto power lines. Disruptions affected 3000 customers in Fredericksburg and Spotsylvania and King George Counties.
February 12, 2000	Winter Weather	0	Low pressure moved from Tennessee to the North Carolina Coast on the 12th, spreading snow across the Central Shenandoah Valley and the Northern and Central Piedmont. Periods of light snow occurred from sunrise to late afternoon with accumulations ranging from 1 to 5 inches. A period of freezing drizzle also occurred around sunset.
December 13, 2000	Winter Weather	0	A strong cold front brought chilly air into the region on the 12th. By the afternoon of the 13th, an upper level disturbance brought warm air into the mid levels of the atmosphere and caused snow that fell from the system to melt to rain on its way down. When the rain hit the ground where temperatures were below freezing, ice accumulated.
February 22, 2001	Winter Storm	0	This system produced mainly light to moderate snowfall across the region between 9 AM and 10 PM. Snowfall amounts ranged from 2 to 5 inches. A 50 vehicle crash occurred on the northbound lanes near Masaponax in Spotsylvania County. The accident occurred as motorists crested the top of a hill, hit near zero visibility, and slammed on their breaks. Three people were treated for serious injuries and another 18 suffered minor injuries. The highway remained closed for three hours while the wreckage was cleared. A 30 vehicle pileup occurred on the southbound lanes just north of the Falmouth/Route 17 interchange in Stafford County. As whiteout conditions struck, three cars slid into each other. Within seconds, the minor fender bender turned into a pileup including tractor trailers, cars, trucks, and an empty bus. Three people were injured and the highway was blocked for nearly three hours.

Date	Event	Property Damage ($)	Comments
January 3, 2002	Winter Storm	0	Low pressure tracked across extreme southeast Virginia during the morning of the 3rd. This storm brought light to moderate snowfall to the Central Piedmont and Fredericksburg areas between 5 AM and 3 PM. In Stafford County, an inch of snow caused slippery roads and delayed school openings. In Spotsylvania and King George Counties, snowfall totals ranged from 3 to 5 inches.
January 19, 2002	Winter Weather	0	Low pressure that moved across North Carolina on the 19th brought mixed precipitation to the region between 6 AM and 11 PM. In most locations, the precipitation started off in the form of snow, and then changed to a mix of sleet and rain around midday.
December 5, 2002	Winter Storm	0	This storm produced accumulating snowfall across the entire region as it moved by. Across the Central Piedmont and Fredericksburg area, freezing rain and sleet was mixed in with the snow. The snow and sleet accumulations ranged from 4 to 6 inches in this area.
February 6, 2003	Winter Storm	0	Low pressure tracked from the Gulf Coast to the Carolinas on the 6th then off the Atlantic coast on the 7th. This storm dropped light to moderate snow between the evening of the 6th and Noon on the 7th. Accumulations ranged from 3 to 7 inches.
February 14, 2003	Winter Storm	8.9M	A complex storm system produced copious amounts of wintery precipitation across the northern third of Virginia between the evening of the 14th and midday on the 18th. After the precipitation came to an end, record breaking snow and sleet accumulations were reported.
February 26, 2003	Winter Weather/mix	0	A series of low pressure systems that tracked from the Gulf Coast to Cape Hatteras dropped light snow off and on between the morning of the 26th and midday on the 28th. A total of 5 to 8 inches of snow accumulated across the northern third of Virginia during the storm. Minor traffic accidents were reported after the fallen snow made roads slippery.
December 14, 2003	Winter Weather/mix	0	An area of low pressure developed over the Gulf Coast region and tracked northeast into the Mid Atlantic region. The storm produced a mixture of snow, sleet and freezing rain. Snowfall totals across Northeast Virginia averaged 3 to 4 inches.
January 25, 2004	Winter Weather/mix	0	An area of low pressure developed off the coast of North Carolina and tracked north. This storm produced widespread snow, sleet and freezing drizzle over the region. Two to four inches of snow fell over the Central Foothills and the Northern Piedmont of Virginia. The snow mixed with sleet and finally changed over to freezing drizzle before tapering off. Several other minor accidents occurred according to Emergency Operations Centers. Dozens of school districts closed.
February 5, 2004	Winter Weather/Mix	0	A low pressure system produced freezing rain and sleet in Northern Virginia. 1 to 2 tenths of ice accumulated. The ice coated surfaces downed power lines and felled trees. There were several school closures/delays, automobile accidents, and power outages. In Stafford County, an automobile accident claimed the lives of two students as they traveled to school. A third student was seriously injured.

Date	Event	Property Damage ($)	Comments
December 5, 2005	Heavy Snow	40K	A winter weather storm produced 4 to 6.5 inches of snow across Northern Virginia. There were reports of trees down in Stafford County due to heavy snow accumulations.
February 11, 2006	Heavy Snow	250K	Storm snowfall across Northern Virginia produced between 8 and 14 inches. There were reports of isolated drifting of snow and downed powerlines throughout the region. This caused over 300,000 customers to be without power in the greater Washington/Baltimore area.
February 24, 2007	Winter Storm	0	A low pressure system produced storms that released 5 inches of snow with some locations reporting as much as 11 inches in Northern Virginia. Sleet and freezing rain mixed with snow at times causing icy conditions on roadways. Several schools delayed school openings by two hours due to icy roadways on Monday, February 26th.
March 1, 2009	Winter Storm	0	A low pressure system produced storms releasing averaged snowfall totals of 5 inches across Stafford County and the rest of Northern Virginia.
December 18, 2009	Winter Storm	0	A winter storm produced snowfall amounts between 19 and 23 inches across Stafford County.
January 30, 2010	Winter Storm	0	Snowfall amounts around 5 to 6 inches were reported across Stafford County.
February 2, 2010	Winter Weather	0	Snowfall averaged 3 to 4 inches across the county.
February 5, 2010	Winter Storm	5K	Snowfall amounts between 13 and 17 inches were reported across Stafford County. Power outages were reported due to the weight of the snow on trees and power lines. School closures continued through the following week.
January 11, 2011	Winter Weather		Low pressure tracked through the Ohio Valley on the 11th before transferring its energy to another area of low pressure off the Mid-Atlantic Coast during the evening hours. A period of snow associated with these systems affected the area during the late afternoon and evening hours of the 11th. Upslope snow continued into the early morning hours of the 12 for locations along and west of the Allegheny front. A trace of freezing rain accumulation was reported across portions of the county.
January 17, 2011	Winter Weather		Low pressure tracked up the Mid-Atlantic Coast on the 17th before moving toward New England on the 18th. Precipitation overspread the area on the night of the 17th ahead of the low. Warmer air was drawn into the system, but cold high pressure over New England kept enough low-level cold air in place for a prolonged period of frozen precipitation into the early morning hours of the 18th. Ice accumulation from freezing rain was around one tenth of an inch near Brookfield.

Date	Event	Property Damage ($)	Comments
March 27, 2011	Winter Weather		A wave of low pressure quickly passed by to the south during the morning hours of the 27th. High pressure to the north supplied enough cold air to cause precipitation associated with the low to fall in the form of snow. Snowfall totaled up to 2.0 inches near Stafford.
January 20, 2012	Winter Weather		Low pressure passed through the area during the evening of the 20th into the morning hours of the 21st. There was enough cold air for precipitation to start off as snow, but warmer air eventually wrapped into the system, causing precipitation to change to a wintry mix. Snow and sleet accumulations were reported to be around seven tenths of an inch near Stafford. A glaze of ice accumulation from freezing rain was also estimated.
February 19, 2012	Winter Weather		Low pressure passed by to the south while high pressure to north pumped in cold air. Precipitation associated with the low fell in the form of snow across central Virginia. A snowfall report of 2.0 inches was reported near Roseville.
March 5, 2012	Winter Weather		A potent area of low pressure tracked through southern Virginia during the morning and early afternoon hours of the 5th. A band of precipitation developed on the northern side of the low. There was enough cold air for precipitation to fall in the form of snow, and the heaviest snow was across central Virginia. Snowfall was estimated to be between two and four inches across the county.
January 23, 2013	Winter Weather		A positively tilted trough of low pressure moved through the Mid Atlantic while a weak clipper system moved through Central Virginia. Cold temperatures and banding produced advisory level snowfall accumulations. Snowfall amounts of 2 inches were reported during the morning rush hour.
January 25, 2013	Winter Weather		An Alberta clipper moved through the Mid Atlantic producing light snow for most of the region. Dry air at the surface limited snowfall amounts for most of the area. Snowfall amounts of around one inch was reported at Arkendale and surrounding locations during the evening rush hour.
February 1, 2013	Winter Weather		A clipper system moved through the Mid Atlantic in the early morning hours and produced advisory level snowfall in the Baltimore and Washington DC metro areas. Snowfall amounts of around an inch were reported at surrounding locations during the morning rush hour.
March 5, 2013	Winter Storm		Strong low pressure impacted the Mid Atlantic bringing rain and snow to the region. A rain-snow line was present across the I-95 corridor where snowfall accumulations dropped off significantly from west to east. Snowfall amounts of 7 inches were reported at Glendie.
March 17, 2013	Winter Weather		Low pressure developed along a stationary front south of the Washington DC. Surface temperatures were marginal and snowfall accumulated west of the I-95 corridor. A cold air damming situation formed during the event and led to accumulating snow across the Shenandoah Valley and Central Foothills. Snowfall was estimated to be around one to two inches based on observations nearby.
March 24, 2013	Winter Weather		Coastal low pressure impacted the Mid Atlantic region with snow and rain showers. Surface temperatures were marginal during the event and a sharp gradient of snowfall accumulation existed in the vicinity of Washington DC. Snowfall amounts were estimated to average between one and three inches across the county based on observations nearby.

Date	Event	Property Damage ($)	Comments
December 8, 2013	Winter Storm		High pressure was wedged down the east coast and surface temperatures fell below freezing. Low pressure developed across the gulf coast states and moved across the Ohio Valley. Snow began but changed over to sleet and freezing rain as warmer temperatures aloft overran the cold air at the surface. Ice accumulations of a quarter inch were measured at Hartwood.
January 2, 2014	Winter Weather		Low pressure tracked across the Mid Atlantic and led to accumulating snow with the highest amounts from Northern Virginia to East-Central Maryland. Low pressure quickly moved off the coast. Snow accumulations of two inches or more were measured at surrounding locations.
January 10, 2014	Winter Weather		A weak disturbance crossed the Mid Atlantic while a wedge of high pressure was at the surface. Precipitation that fell melted aloft and froze on contact. Ice accumulations of a trace or more were measured at surrounding locations.
January 21, 2014	Winter Weather		A shortwave trough moved into the region while low pressure developed south of the Mid Atlantic. Upper level dynamics led to moderate to heavy snow to move into the region. Snow accumulations of two inches or more were measured at surrounding locations.
January 28, 2014	Winter Weather		Low pressure moved along the east coast while a shortwave trough moved into the Mid Atlantic from the west. Accumulating snow moved into the Piedmont and Southern Maryland. Snow accumulations of two inches were measured at surrounding locations.
February 4, 2014	Winter Weather		Ice accumulation of a trace or more was reported at surrounding locations.
February 12, 2014	Winter Storm		Low pressure moved up the east coast and approached the Mid Atlantic. High pressure was located across New England and fed cold air into the region. Heavy snow fell across most parts of the Mid Atlantic with the highest amounts near the Mason Dixon line where mid level forcing led to a heavy band. Snow accumulations of 6 or more inches were measured at Stafford.
February 25, 2014	Winter Weather		A upper level disturbance moved across the region in the morning. Temperatures were well below freezing and snow showers accumulated on surfaces. Snow became heavier across the Washington DC metro and Southern Maryland. Snow accumulations of two inches or more were measured at surrounding locations.
March 3, 2014	Winter Storm		A cold front crossed the region as low pressure passed across the south of the Mid-Atlantic and heavy snow moved across the region. Temperatures dropped from north to south and precipitation changed from rain to sleet/freezing rain to snow. Snow accumulations of five or more inches was measured at Falmouth.
March 7, 2014	Winter Storm		Ice accumulation of a trace was reported at surrounding locations.
March 16, 2014	Winter Storm		Two areas of low pressure formed south of the Mid Atlantic. Dry and cold air at the surface led to precipitation to quickly change to snow. Heavy snow fell across the region with a confined area of greater than 10 inches across the Central Foothills. Snow accumulation of five or more inches was measured at Hartwood.
March 18, 2014	Winter Weather		Ice accumulation of a trace was reported at surrounding locations.

Date	Event	Property Damage ($)	Comments
March 25, 2014	Winter Weather		Low pressure moved past the Mid Atlantic from the Carolinas. High pressure to the north fed freezing temperatures to the region resulting in snow to accumulate across the region. Snowfall occurred during the morning rush for the Baltimore/Washington DC and Interstate 95 corridor. Snow accumulation of 2 inches or more was measured at surrounding locations.
February 16, 2015	Winter Storm		A surface low formed over Texas, then quickly moved east during the day and overnight, pushing off the Carolina coast by the morning of the 17th. A very cold airmass in place from retreating Arctic high pressure resulted in higher than average snow ratios, between 12:1 and 15:1. Central Virginia received the highest amounts, with lower amounts to the north and west. Between 5.0 and 7.0 inches was reported by multiple sources in the county and surrounding areas.
February 21, 2015	Winter Weather		Low pressure lifting from the Ohio River Valley into the eastern Great Lakes dragged a cold front through the region. Southerly flow ahead of the front resulted in high moisture advection and with temperatures hovering in the 20s, moderate to heavy snow was reported across the region. Snow totals between 2.0 and 3.0 inches was reported. Ice totals between a trace and 0.10 inches was reported.
February 25, 2015	Winter Weather		Low pressure passing to the south brought widespread snow. Approximately 3.0 inches was reported.
March 1, 2015	Winter Weather		Widespread precipitation was produced ahead of an approaching cold front. Southerly flow overrunning near freezing surface temperatures led to the main precipitation type being freezing rain. Storm total ice of around 0.10 inches was reported around the county.
March 5, 2015	Winter Storm		A cold front brought widespread heavy snow to the area with a strong convergence zone aligning across northern Virginia into eastern Maryland resulting in mesoscale banding and higher snow totals. Storm total snow between 5.0 and 7.0 inches was reported around the county and in surrounding areas.
January 1, 2016	Winter Weather		A shortwave trough swung through the Mid-Atlantic during the later afternoon and evening hours. A quick burst of snow occurred during the peak of rush hour and with below freezing temperatures already place, led to accumulations of up to one inch. Hundreds of traffic incidents were reported with icy conditions forming on the roadways. Spotters reported around half of an inch across the county.
January 22, 2016	Winter Storm		Coastal low pressure rapidly intensified as it tracked up the Mid-Atlantic coast. At the same time, high pressure to the north was funneling cold air into the region. The strong low pressure system was able to tap into moisture from the Gulf of Mexico and the Atlantic Ocean resulting in heavy amounts of precipitation. The cold air caused that precipitation to fall in the form of snow. Gusty winds also accompanied this storm. The combination of gusty winds and low visibility along with snow and blowing snow caused blizzard conditions across portions of northern Virginia. Snowfall amounts between 15 and 24 inches were reported across Stafford County.

Date	Event	Property Damage ($)	Comments
February 14, 2016	Winter Storm		Prolonged event impacted the Mid-Atlantic. Southwest flow aloft overriding northeast flow at the surface from departing high pressure led to snow spreading over the region initially. Low pressure formed and organized over the Gulf of Mexico, eventually pushing off to the northeast and impacting the region on the 15th. As the cold air wedge was eroded away from this low, warming at all levels led to the snow transitioning to sleet and ice for most of the area. Between 5 and 8 inches of snow was reported.
March 3, 2016	Winter Storm		Low pressure tracked through the Southeast US before pushing northeast, just off the Carolina coast. The low deepened quickly just offshore as the northern and southern stream energy pieces phased, but far enough east where only fringes of southern Maryland received warning level snow, with less snow amounts to the north and west. Between 1-2 inches was reported across the county, impacting rush hour.

Source: National Climatic Data Center, 2016

GEORGE WASHINGTON
REGIONAL COMMISSION

5:
Vulnerability Assessment

5 - VULNERABILITY ASSESSMENT

The vulnerability assessment estimates the extent of injury and damages that may result from various natural hazards within the GWRC region. Vulnerability can be quantified in some instances where there is an identified hazard area, and where unique data can be applied to such an estimate. In these instances, the numbers and types of buildings subject to the hazard can be counted and their values tabulated. In cases where no definitive data exists, estimates of potential damage can still be attempted by using past events as a rough predictor of the future.

This chapter includes an analysis of the risks associated with each hazard, and the vulnerability of localities within the GWRC region. The risk analysis includes total potential loss estimates based on the amount of infrastructure in the jurisdiction, the number of critical facilities that would potentially be affected, loss of business where appropriate, as would be affected by the location, extent, and severity of a potential hazard occurrence. In order to conduct this analysis, the infrastructure, population, and development in each jurisdiction was updated using the best available data.

In the previous section, this plan identified a range of natural hazards faced by the GWRC region, drawing particular attention to those with medium to high hazard potential based on past events and local judgment. Some hazards, such as draught, are broad, general conditions whose impact will be felt by the entire region, while other hazards, such as floods, have impacts that are highly focused, and are based on specific features such as local topography.

For the purpose of assessing hazard vulnerability in the GWRC region, this plan considers hazards in two groups; those hazards which are likely to impact the entire region equally when they occur, and those whose effects will be more specific or localized.

Regional Vulnerability Assessment

- Drought;
- Severe Weather, including
  - Extreme heat;
  - Northeasters;
  - Thunderstorms;
  - Tornadoes; and
  - Winter Storms;
- Sinkholes and Landslides
- Dam Failure

Community Specific Vulnerability Assessment

- Flooding;
- Hurricanes; and
- Wildfire.

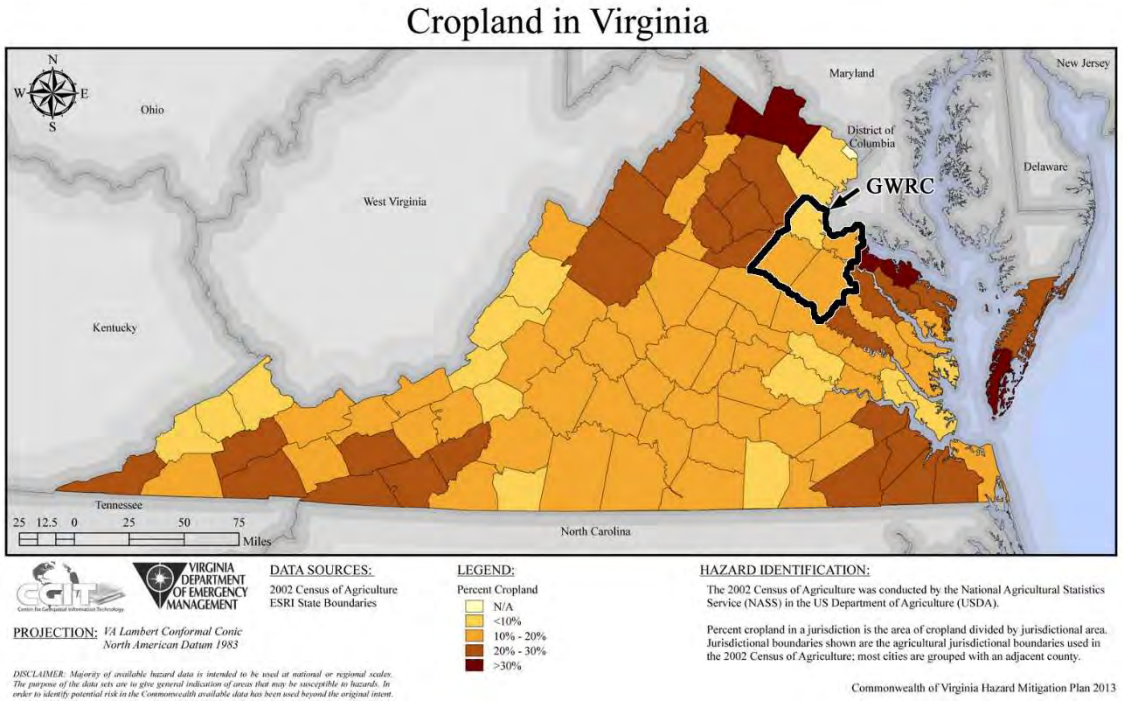
5.1 - Regional Vulnerability Assessment

Natural hazards that were classified as affecting the entire GWRC region were drought and various types of severe weather events. For these hazards, the potential impacts are presented below.

5.1.1 - Drought Regional Vulnerability Assessment

Drought impacts may include physical, bio-physical, social and economic consequences. Physically, there may be a reduction in water supply for drinking, domestic, and irrigation purposes with a subsequent impact of increased pumping costs. The ground water level may be depleted and the flow of perennial water sources reduced. Bio-physical impacts include damage to crop quantity and quality, damage to wildlife and habitat, an increase in invasive/noxious weeds, and the deterioration of water quality. Economically, there may be a loss in livestock production and increased prices for commodities.

Despite rapid suburbanization in some areas, agricultural remains a major industry in the GWRC region. The USDA Census reveals that in 2007 there were 997 farms in the Counties of Caroline, King George, Spotsylvania, and Stafford. By, 2012 the number decreased to 965. The total acreage of farms within the region also decreased between 2007 and 2012 from 164,313 acres to 138,110 acres. However, as the number and size of farms has decreased across the region, the economic impact of farms has increased. The market value of crops in the region for 2007 was $26,237,000, growing to $37,911,000 by 2012. This leaves the potential economic impact of a drought to the region as staggering.

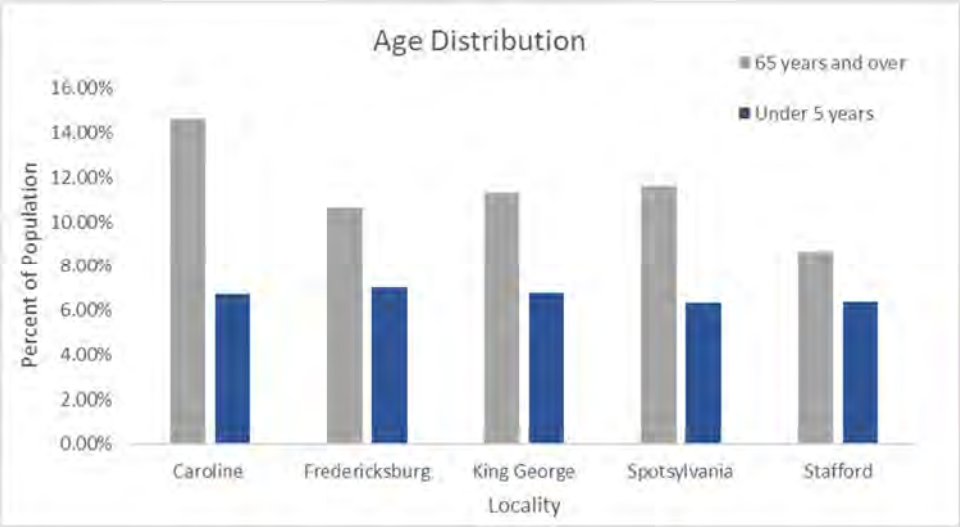


Drought Risk. Percent Cropland by County. VDEM.

5.1.2 – Extreme Heat Regional Vulnerability Assessment

High heat and humidity (high Heat Index) can present dangers to human life. When heat gain exceeds the level the body can remove, body temperature begins to rise, and heat related illnesses and disorders may develop, including damage to the brain and vital organs. The Heat Index (HI) is the temperature the body feels when heat and humidity are combined. According to the Centers for Disease Control and Prevention (CDC), infants and children up to 4 years of age, as well as people 65 years of age and older, are at greatest risk for heat-related illness.

The GWRC region is home to significant populations of young children and adults over 65, both of whom may be especially impacted by extreme heat hazards. As described in the chart below, populations over age 65 range from approximately 8% in Stafford County to over 14% in Caroline County, while populations of children under the age of 5 are between 6% and 8% across the GWRC region. (*CDC Frequently Asked Questions About Extreme Heat, 2017*)



5.1.3 - Hurricane Regional Vulnerability Assessment

The severe weather scenarios evaluated by this plan – hurricanes, tornados, and winter storms - all share common impacts, including damage to infrastructure, particularly damage to overhead power and communication lines, road closures, and interruption in business and school activities. Utility outages can impact anything relying on electricity, and include secondary impacts such as interruption to water and sewage services, heat and refrigeration, fuel supplies, computers and cell phones. If interruption to business occurs for an extended period, economic impacts can be severe. Also of concern would be the impacts on populations with special needs such as the elderly and those requiring the use of electric medical equipment. Depending on the nature of a given storm, all areas within the George Washington region are equally at risk; however, those areas relying on above ground utilities could suffer the greatest damage.

FEMA's HAZUS tool was utilized to perform a hurricane hazard analysis for the George Washington Region to estimate potential loses in the event of natural disasters. HAZUS has the ability to calculate earthquake, hurricane, and flood hazards as well as potential economic losses associated with these hazards. The following table lists the number and dollar value of exposed structures based on occupancy type for the George Washington Region.

Number and Dollar Value of Exposed Structures from HAZUS – GW Region

Structure Type	Number of Exposed Structures	Total $ Value Exposed Structures
Residential	109,732	36,455,918,000
Commercial	4,976	3,795,950,000
Other	2,662	1,684,495,000
Total	**117,370**	**41,936,363,000**

Source: HAZUS

The default data set provided for HAZUS is based on the 2012 census data. It is recognized that the current development trends in the George Washington Region may render the 2012 census data, with which HAZUS is programmed, somewhat obsolete. However, this analysis depicts the probability of occurrence and can generally be used to estimate potential damages due to high winds.

The two options provided by HAZUS software for wind analysis are the probabilistic and deterministic methods. The probabilistic scenario is the default option for the software and activates a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year. The deterministic method analyzes hazards associated with a user defined storm event. The user inputs the storm track, forward speed, and wind speed and allows for the creation of "what-if" scenarios.

The probabilistic wind analysis was chosen because it provides the statistical probability for a range of hurricane events and presents a comparison of these events. The probabilistic analysis was used to generate structural loss estimations for hurricane events with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. The recurrence interval is the average interval of time within which the given hurricane event will be equaled or exceeded once.

Because residential structures comprise a very large percentage of the structures within the region, these data are presented in the following table below. Minor damage to a structure is defined as receiving minimal damage and is habitable without repairs. A moderately damaged structure is uninhabitable. Minor repairs are necessary to make it habitable. These repairs will take less than 30 days. Severely damaged structures are currently uninhabitable; extensive repairs are necessary to make habitable. These repairs will take more than 30 days. Totally destroyed structures are a total loss. These structures may not be economically feasible to rebuild. The included table shows the dollar value of forecast economic losses for the same 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year probability storms, both in capital loss, and in terms of lost income via business interruption.

Hurricane Risk – GW Region. Summary of Probability Analysis – Residential Structures

Return Period	Residential Building Damage			
	Minor Damage	Moderate Damage	Severe Damage	Total Destruction
10-year	0	0	0	0
20-year	1	0	0	0
50-year	25	10	0	0
100-year	75	1	0	0
200-year	411	9	0	0
500-year	2,892	160	0	0
1000-year	4,739	272	1	2

Source: HAZUS

Hurricane Risk – GW Region. Summary of Probability Analysis – Economic Loss

Return Period	Property Damage – Capital Loss		Business Interruption
	Residential ($)	Total ($)	Income Loss ($)
10-year	0	0	0
20-year	70,000	70,000	0
50-year	7,002,000	7,030,000	0
100-year	28,354,000	28,891,000	2,000
200-year	72,011,000	72,634,000	59,000
500-year	180,238,000	182,519,000	4,664,000
1000-year	264,403,000	267,903,000	6,201,000

Source: HAZUS

5.1.4 - Tornado Regional Vulnerability Assessment

Tornados are a region-wide threat, with no individual locality at greater risk than others. While tornado reports for the GWRC region have been relatively few and minor, the risk of future tornadoes is real, and their potential to cause significant damage great.

Based on available data, the George Washington Region has averaged 1.12 tornado events annually, causing an average of $260,065 in damages.

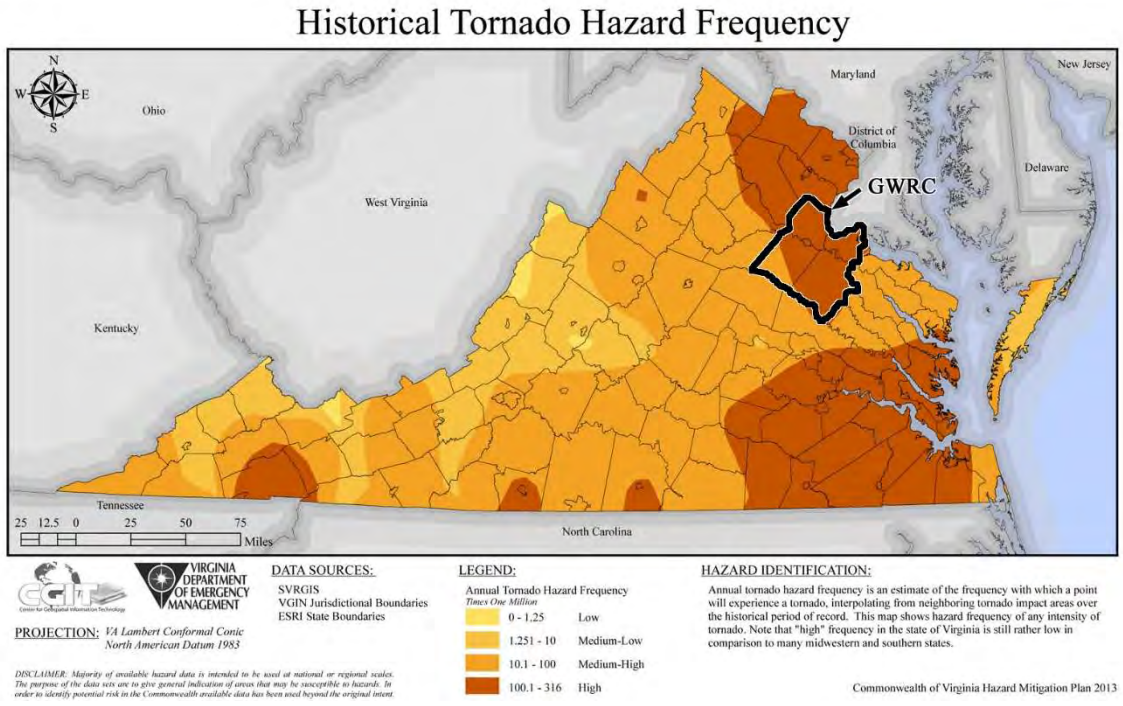
The severe weather scenarios evaluated by this plan – hurricanes, tornados, and winter storms - all share common impacts, including damage to infrastructure, particularly damage to overhead power and communication lines, road closures, and interruption in business and school activities. Utility outages can impact anything relying on electricity, and include secondary impacts such as interruption to water and sewage services, heat and refrigeration, fuel supplies, computers and cell phones. If interruption to business occurs for an extended period, economic impacts can be severe. Also of concern would be the impacts on populations with special needs such as the elderly and those requiring the use of electronic medical equipment. Depending on the nature of a given storm, all areas within the George Washington

region are equally at risk; however, those areas relying on above ground utilities could suffer the greatest damage.

Summary of Historic Tornado Events – GW Region 1975-2016

Intensity	Number of Occurrences	Damages	Injuries
EF0	19	$292,000	0
EF1	22	$1,171,000	0
EF2	3	$10,450,000	1
N/A	2	$50,000	2

Source: SVRGIS and NCDC, 2016



Tornado Risk. Frequency of Past Events. VDEM.

5.1.5 – Winter Storm Regional Vulnerability Assessment

Winter storms can be very disruptive, particularly in areas such as the GWRC region where they do not occur frequently. Strong winds can damage trees, utility poles, and power lines. Accumulations of ice can also bring down trees, electrical wires, telephone poles and lines, and communication towers. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Heavy snow can immobilize a region stranding commuters, closing schools, stopping the flow of supplies, and disrupting emergency and medical services. Heavy accumulations of snow have the potential to collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and

unprotected livestock may be lost. The cost of snow removal, repairing damages, and loss of business can also have a significant economic impact on communities.

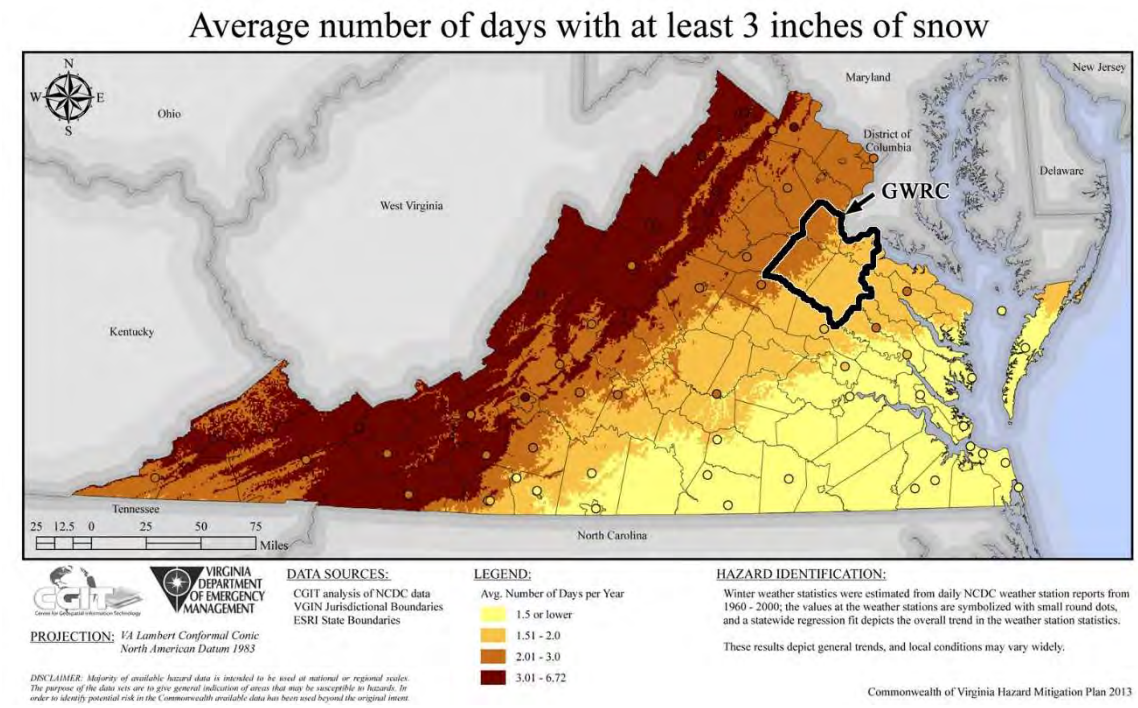
Since 1960 the George Washington region has experienced extreme winter weather in the form of snow and ice that has caused damages to private and public properties as well as to crops within the region. Total damages to properties exceeded $340 million across 67 storms. This works out to roughly $7 million in damages done annually by winter storms. Past data also indicates that on average the number of winter storm events annually is approximately 1.4. Five of those storms caused winter freeze resulting in crop damages exceeding half a million dollars.

Since 2000, there have been four federally declared disasters related to winter storms events that impacted the region. The total of funds distributed in the form of public assistance grants was $106,269,763.66 for the entire state of Virginia (FEMA, 2017).

Winter Storm Risk—GW Region

Locality	Average Snowfall (inches) 1958-2010					Likelihood Of Event (%)
	December	January	February	March	Annual	
Caroline	2.51”	4.54”	4.86”	2.43”	15.70”	99.9
Fredericksburg	2.55”	5.20”	4.53”	2.35”	14.47”	96.1
King George	1.91”	3.41”	3.26”	1.67”	10.25”	85.3
Spotsylvania	2.68”	5.72”	4.26”	2.90”	16.34”	93.1
Stafford	3.21”	3.46”	4.11”	2.42”	14.10”	96.3

Source: Southeast Regional Climate Center



Winter Storm Risk. Average Days with Significant Snowfall. VDEM.

5.1.6 – Sinkhole and Landslide Vulnerability Assessment

Both sinkholes and landslides should be considered semi-natural hazards in the context of the GWRC region. While natural topographic features such as degrading limestone may cause sinkholes, and while erosion of naturally steep slopes may cause damaging landslides, these dangers are virtually unknown as natural conditions in the region. Instead, sinkholes in this region may sometimes be caused when underground stormwater pipes fail, allowing rushing water to erode soil, eventually causing the collapse of the ground above. Similarly, landslide events can occur in the region, but are confined mainly to man-made slopes that have been improperly graded, or the failure of constructed retaining walls. Occasional sinkhole and landslide events have included a September 2011 landslide involving the failure of a constructed slope in the Austin Ridge subdivision in Stafford County, and a November 2012 sinkhole caused by failed underground infrastructure that briefly closed lanes of US 17 in Stafford County.

Because these hazards are small in scale, highly localized, and rooted more in human intervention than in nature, sinkhole and landslide hazards cannot be adequately assessed from a hazard mitigation standpoint. Although future occurrences of either hazard are possible in the region, determining the probability of such events, or the potential impact of such events, is not possible given the number and varied scope of contributing factors.

5.1.7 – Dam Failure Vulnerability Assessment

Like sinkholes and landslides, dam failure should be considered a semi-natural hazard. Dams are created by human intervention, but may cause flooding and erosion in the event of their failure. Dam failure can occur if pressure behind the dam exceeds design capacity, or overtopping causes rushing water to scour the base of the dam. The Virginia Soil and Water Conservation Board (VS&WCB) established the Virginia Dam Safety Program to provide for dam safety. Dams that meet specific regulatory criteria must obtain operation and maintenance certificates, and provide emergency action plans to local emergency officials.

The U.S. Army Corps of Engineers (USACE) compiles a National Inventory of Dams (NID), ranking each dam on its downstream hazard potential in the event of failure. The following table shows the number of dams in each community based on their NID ranking of downstream hazard potential. Downstream hazard potential is rated Low if damage would likely be limited to the owner's property, with no probable loss of human life and low economic or environmental loss. Ratings of Significant indicate no probable loss of human life, but the possibility of economic loss or the disruption of lifeline facilities. Downstream hazard potential is rated High when the failure of a dam would likely cause the loss of human life.

While the Virginia Department of Conservation and Recreation (DCR) makes dam failure inundation maps available, it does not attempt to estimate potential downstream impacts of such inundation should a dam fail. Some GWRC localities have begun to combine inundation maps with local mapping of parcels and structures. Additionally, individual dam emergency action plans may quantify downstream hazards. However, there remains no complete or standardized data quantifying the vulnerability of life or property as the result of dam failures in the region. Regional authorities should pursue solutions to this data gap, particularly for the few, but important, high hazard dams found in the GWRC region.

Hazard Potential for Dam Failure - GWRC Region

	High	Significant	Low
Caroline County	3	35	51
City of Fredericksburg	0	0	0
King George County	1	1	8
Spotsylvania County	5	7	9
Stafford County	7	11	6
GWRC Total	**16**	**54**	**74**

Source: National Inventory of Dams – as reported by Virginia Department of Emergency Management.

5.2 - Community Specific Vulnerability Assessment

In conducting the 2017 plan update, the committee returned to its 2012 conclusions that the GWRC region faces three specific hazards which may affect the various jurisdictions within the region differently. These hazards are flooding, hurricanes, and wildfire. For this reason, specific vulnerability analysis was carried out for each of these hazards as they affect each locality within the region. Community vulnerability can be quantified in these instances where there is a known, identified hazard area. The numbers and types of buildings subject to the identified hazard can be counted and their values tabulated. Past events can also serve as a rough predictor of the future. Where the data was available, rough estimates of annualized damages and the number of hazard events is noted. Together, these values reflect the impact, or vulnerability, of these areas to specific natural hazards.

Flood Vulnerability

Excess water from snowmelt, rainfall, or storm surge can accumulate and overflow onto adjacent floodplains. While many floodplain boundaries are mapped by FEMA's National Flood Insurance Program (NFIP), floods sometimes go beyond the mapped floodplains or change courses due to erosion, sedimentation, or human development like building, grading, and debris blockage. Since the floodplains in the United States are home to over nine million households, flood vulnerability is extremely high, with potential for moving water to destroy structures and wash away vehicles and other debris, and for property damage resulting from inundation by sediment and debris-filled water.

FEMA's HAZUS tool was utilized to perform a hurricane hazard analysis for the George Washington Region to estimate potential loses in the event of natural disasters. HAZUS has the ability to calculate earthquake, hurricane, and flood hazards as well as potential economic losses associated with these hazards. The following table lists the total dollar value of exposed structures based on occupancy type for the George Washington Region.

Number and Dollar Value of Exposed Structures from HAZUS – GW Region

Structure Type	Number of Exposed Structures	Total $ Value Exposed Structures
Residential	109,732	36,455,918,000
Commercial	4,976	3,795,950,000
Other	2,662	1,684,495,000
Total	**117,370**	**41,936,363,000**

Source: HAZUS

Direct Economic Annualized Losses for Buildings – GWRC Region
Capital Stock Losses – 100 Year Flood Event

	Building Loss	Contents Loss	Inventory Loss	Building Loss Ratio
Caroline	$24,220,000	$21,004,000	$240,000	4.4%
Fredericksburg	$38,471,000	$26,862,000	$226,000	1.0%
King George	$8,325,000	$6,969,000	$38,000	0.9%
Spotsylvania	$63,164,000	$52,114,000	$720,000	1.8%
Stafford	$14,613,000	$11,758,000	$165,000	1.3%
TOTAL	**$148,793,000**	**$118,707,000**	**$1,389,000**	**1.9%**

HAZUS, 2016.

Direct Economic Annualized Losses for Buildings – GWRC Region
Income Losses – 100 Year Flood Event

	Relocation Loss	Capital Related Loss	Wages Lost	Rental Income Loss
Caroline	$13,000	$45,000	$45,000	$11,000
Fredericksburg	$34,000	$19,000	$28,000	$13,000
King George	$0	$4,000	$15,000	$0
Spotsylvania	$49,000	$53,000	$96,000	$8,000
Stafford	$7,000	$11,000	$27,000	$1,000
TOTAL	**$103,000**	**$132,000**	**$211,000**	**$33,000**

HAZUS, 2016.

Critical Facilities in 100-year flood plain-GW Region

Locality	Total at Risk Critical Facilities
Caroline County incl. Towns of Port Royal and Bowling Green	0
City of Fredericksburg	17
King George County	3
Spotsylvania County	11
Stafford County (excl. Quantico)	1
George Washington Region Total	**32**

Wildfire Vulnerability

The Virginia Department of Forestry tracks wildfire events, including their location, size, frequency, and damages caused. Using this data, among other resources, VDOF classifies areas of the state based on their relative fire risk. This plan intersects wildfire area classifications generated by the VDOF with local parcel mapping and tax assessment data to determine the number of parcels located within high wildfire risk zones, and to quantify the value of real estate improvements (mainly buildings) that would be at risk in the event of a wildfire. individual counties and city that is encompassed by the GW Region provided hardcopy tax parcel information. Of particular importance to this analysis are the number of critical community facilities located within high wildfire risk areas. Government buildings, emergency facilities, schools, and other critical locations must be able to continue their function in the event of natural disasters. These facilities are best located in the least vulnerable areas of the locality, or should have contingency plans in place should they themselves be affected by natural hazards.

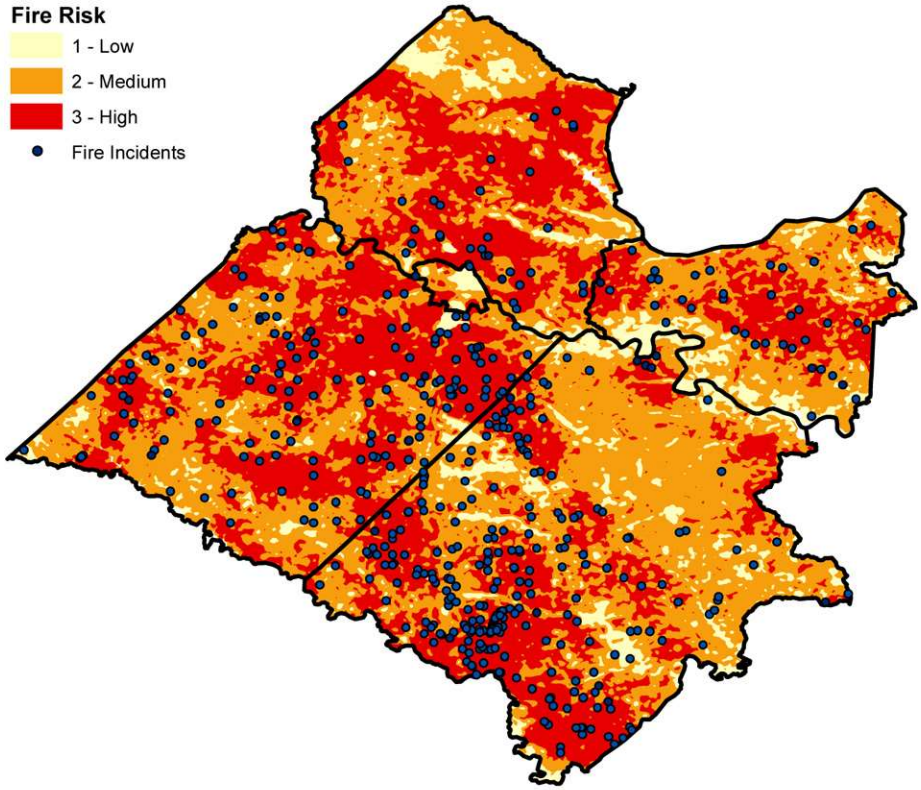
Wildfire Risk-GW Region

Locality	Total No. Parcels	No. Parcels in High Wildfire Zone	Estimated at Risk Value
Caroline County incl. Towns of Port Royal and Bowling Green	25,402	15,607	$1,516,776,500
City of Fredericksburg	8,432	1,454	$503,429,300
King George County	13,889	6,935	$938,925,400
Spotsylvania County	63,817	43,267	$3,489,403,800
Stafford County	56,871	38,331	$8,469,310,400
George Washington Region Total	**168,411**	**105,594**	**$14,917,845,400**

Source: Virginia Department of Forestry, 2016

Wildfire Risk and Critical Facilities-GW Region

Locality	Total at Risk Critical Facilities
Caroline County incl. Towns of Port Royal and Bowling Green	12
City of Fredericksburg	5
King George County	29
Spotsylvania County	71
Stafford County	54
George Washington Region Total	**171**



Regional Wildfire Risk and Past Wildfire Events. VDOF.

5.2.1 - Caroline County Vulnerability Assessment (incl. Towns of Bowling Green and Port Royal)

Development Trends

Caroline County's population increased from 22,121 in the 2000 census to 28,545 in 2010 census, a 29% increase. This growth far exceeded the 13% overall population growth of the State of Virginia for this period. The estimated population of Caroline County for the year 2015 was 29,984. Population projections maintained by the Virginia Employment Commission call for County population to reach 31,400 by 2020 and climb further to 33,447 by 2030.

The leadership of Caroline County has expressed a desire for continued economic growth and development that brings new jobs to the County, while respecting local environmental and historic resources, and balancing the needs of residential, commercial, and industrial interests with the public facilities that support them. (Caroline County Comprehensive Plan 2010).

The County plans for the accommodation of new and future growth in designated growth areas located in or near the areas of Port Royal, Bowling Green-Milford, Carmel Church, Ladysmith and Dawn, and has established specific plans for these areas.

As of 2016, there are 5,744 jobs in Caroline, with local government, public schools, and the US Department of Defense as major employers. Unemployment in the County stands at 4.2% as of October 2016, trailing slightly the Virginia unemployment rate of 4.1%, but better than the national average of 4.7%. While many residents of Caroline are employed, a large number commute to locations outside of the County for work.

The Caroline County Department of Economic Development actively promotes the recruitment of new businesses to the County, as well as school-to-work, alternative education, and workforce training programs that improve the County's employment base. The County has been successful in the recruitment of the CFC Farmers Market and the move of the Virginia State Fair from Richmond to Caroline.

As the County continues to development, areas for future growth should be weighed against areas vulnerable to natural hazards to determine ideal or priority growth areas. Hazard mitigation through land use planning can reduce the cost of future natural hazard events, both in risk to human life and in damage to public and private property.

Critical Facilities

In order to assess the vulnerability of a community to natural hazards, this plan provides an inventory of critical structures and facilities in Caroline County. The critical facilities are the community's assets that are the most important or vital to emergency management. Critical facilities include:

- Emergency Operation Center (EOC);
- Emergency Communications Center (ECC) / 911;
- Law Enforcement Offices;
- Fire / Rescue Stations;
- Emergency Medical Services (EMS);
- Power;
- Communications;
- Water;

- Wastewater Treatment Plants (WWTP);
- Shelters; and
- Administration Buildings / Courthouse.

Critical facilities should be given special attention in preparing for a disaster because of their vital importance to maintaining citizen life, health, and safety during and directly after a disaster event.

Town of Bowling Green

Representatives from Caroline County provided the inventory of critical facilities for the Town of Bowling Green. The listing of critical facilities includes emergency response facilities and public facilities.

Town of Port Royal

Representatives from Caroline County provided the inventory of critical facilities for the Town of Port Royal. The listing of critical facilities is found in the included table.

Critical Facilities – Caroline County

Facility Name	Location	Facility Type
Dept Fire & Rescue Admin. Emergency Operations Center	Caroline County	Fire-Rescue Admin/EOC
Upper Caroline Fire Dept1	Woodford	Fire Dept
Frog Level VFD.2	Hanover	Fire Dept
Ladysmith VFD. 2	Ladysmith	Fire Dept
Sparta VFD. 2	Sparta	Fire Dept
Port Royal VFD. 2	Port Royal	Fire Dept
Frog Level VRS	Ruther Glen	Rescue Squad
Ladysmith VRS	Ladysmith	Rescue Squad
Rappahannock Elec. Field Ofc.	Caroline County	Power Co. local office
St. Johns Sub-Station	Ruther Glen	Electrical Sub Station
Communications Transmit Tower	Varies	Communications
Communications Receive Towers	Varies	Communications
WWUZ CH 2451		Communications
Cell & Microwave Towers	Varies	Communications
Caroline Co. STP	Ruther Glen	Wastewater
Ladysmith Primary2	Ruther Glen	School / Shelter
Bowling Green Primary2	Milford	School / Shelter
Bowling Green Elem	Caroline County	School / Shelter
Ladysmith Elem2	Ruther Glen	School / Shelter
Caroline Middle2	Milford	School / Shelter
Caroline High School	Milford	School / Shelter

Facility Name	Location	Facility Type
Caroline County Courthouse	Bowling Green	Administration Building
Additional significant structures		
CSX/Amtrak Railway	Varies	Transportation
Plantation gas Pipeline	Varies	Gas
Columbia Gas Pipeline	Varies	Gas
School Board Office	Caroline County	School Board
Pneumansend Regional Jail	Caroline County	Jail
Lake Caroline Dam	Ruther Glen	Office
Lake Land'or Dam	Ruther Glen	Office

[1] Data taken from FEMA HAZUS-MH program
[2] Data provided by GWRC
Source: HAZUS and GWRC.

Critical Facilities – Town of Bowling Green

Facility Name	Town	Facility Type
State Police	Bowling Green	Police Departments
Caroline Sheriff Admin.	Bowling Green	Police Departments
Bowling Green Police Dept	Bowling Green	Police Departments
Bowling Green Fire Dept	Bowling Green	Fire Dept
911 Center	Bowling Green	911 Center
Bowling Green Rescue Squad1	Bowling Green	Rescue Squad
Water Main Controls/Ground Storage Well	Bowling Green	Water
Fort AP Hill	Bowling Green	Wastewater
Wastewater Treatment Plant	Bowling Green	Wastewater
Sewer Pump Station	Bowling Green	Sewer
Sewer Pump Station	Bowling Green	Sewer
Town Hall	Bowling Green	Administration Building
Additional significant structures		
Dialysis Center	Bowling Green	Medical
Nursing Home	Bowling Green	Medical

Source: Data provided by the Town of Bowling Green.

Critical Facilities – Town of Port Royal

Facility Name	Town	Facility Type
Port Royal V.F.D. 1	Port Royal	Fire Dept
Town Water Storage Tank	Port Royal	Water
Town Hall	Port Royal	Administration

Source: Data provided by the Town of Port Royal.

Non-Rotational Wind Vulnerability

The HAZUS analysis tool was used to assess the vulnerability of the locality to hurricane wind hazards. Options provided by HAZUS for this analysis are the probabilistic and deterministic methods. The probabilistic scenario is the default option and relies on a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

The probabilistic wind analysis was chosen because it provides the statistical probability for a range of hurricane events and presents a comparison of these events. The probabilistic analysis was used to generate structural loss estimations for hurricane events with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. The recurrence interval is the average interval of time within which the given hurricane event will be equaled or exceeded once.

Because residential structures comprise a significantly large percentage of the occupancy classification within all subject localities, these data are presented in below.

Hurricane Risk – Caroline County incl. Towns of Bowling Green and Port Royal. Summary of Probability Analysis – Residential Structures

Return Period	Residential Building Damage			
	Minor Damage	Moderate Damage	Severe Damage	Total Destruction
10-year	0	0	0	0
20-year	0	0	0	0
50-year	1	0	0	0
100-year	10	0	0	0
200-year	60	0	0	0
500-year	336	13	0	0
1000-year	623	32	0	0

Source: HAZUS, 2016

Hurricane Risk – Caroline County incl. Towns of Bowling Green and Port Royal. Summary of Probability Analysis – Economic Loss

Return Period	Property Damage – Capital Loss		Business Interruption
	Residential ($)	Total ($)	Income Loss ($)
10-year	0	0	0
20-year	0	70,000	0
50-year	1,912,000	1,912,000	0
100-year	5,044,000	5,081,000	0
200-year	11,564,000	11,604,000	4,000
500-year	26,578,000	26,786,000	347,000
1000-year	38,119,000	38,469,000	624,000

Source: HAZUS, 2016

Flood Vulnerability

Repetitive Loss Properties

Caroline County includes 82 properties enrolled in the National Flood Insurance Program (NFIP). At this time, none of these properties is classified as a Repetitive Loss property. A Repetitive Loss property is defined as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP over any rolling 10-year period since 1978. A Severe Repetitive Loss property is defined as any insurable building for which four or more claims of more than $1,000 were paid by the NFIP over any rolling 10-year period since 1978. Repetitive Loss properties strain the resources of the NFIP, while remaining at risk for future property damage, injury, or loss of life. In these cases, the primary objective of the NFIP, and of this plan, is to promote permanent solutions to repetitive flooding problems, either through structural measures that reduce or eliminate the flooding risk, or by removal of structures within high risk flood areas.

HAZUS Flood Analysis

The HAZUS analysis tool was used to assess the structural and economic impact of predicted flood events on the locality. Hazard type options provided by HAZUS for flood analysis are the riverine, coastal, and combined riverine and coastal scenarios. The necessary scenario for any given situation depends upon the geography of the region. If the area is inland with a stream hydrology, then the riverine scenario should be used. If however, the area is along the coast then either the riverine and coastal, or coastal scenario should be used.

The riverine analysis was chosen for Caroline County. This scenario provides the statistical probability for a range of flood events and presents a comparison of those events. The riverine analysis was used to generate structural loss estimations, agricultural loss estimations, and shelter requirements for flood events with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, and 500-year. The recurrence interval is the average interval of time within which the given flood event will be equaled or exceeded once. The data included below represents the likely effects on the 100-year flood event on the community.

Flood Risk – Caroline County incl. Towns of Bowling Green and Port Royal

Occupancy Type	Dollar Exposure (replacement value $)	Percent of total
Residential	1,122,820,000	86.1%
Commercial	100,066,000	7.7%
Industrial	31,140,000	2.4%
Agricultural	6,439,000	0.5%
Religion	25,216,000	1.9%
Government	6,618,000	0.5%
Education	11,650,000	0.9%
TOTAL	**1,303,949,000**	**100.0%**

Source: HAZUS, 2016

In addition to the above cited economic impacts to local structures, HAZUS estimates the displacement of 123 households as the result of a hypothetical 100-year flood event, with 79 people seeking emergency shelter within the community. Damage in the above-forecast amounts to local structures would additionally produce 1,365 tons of flood related building debris.

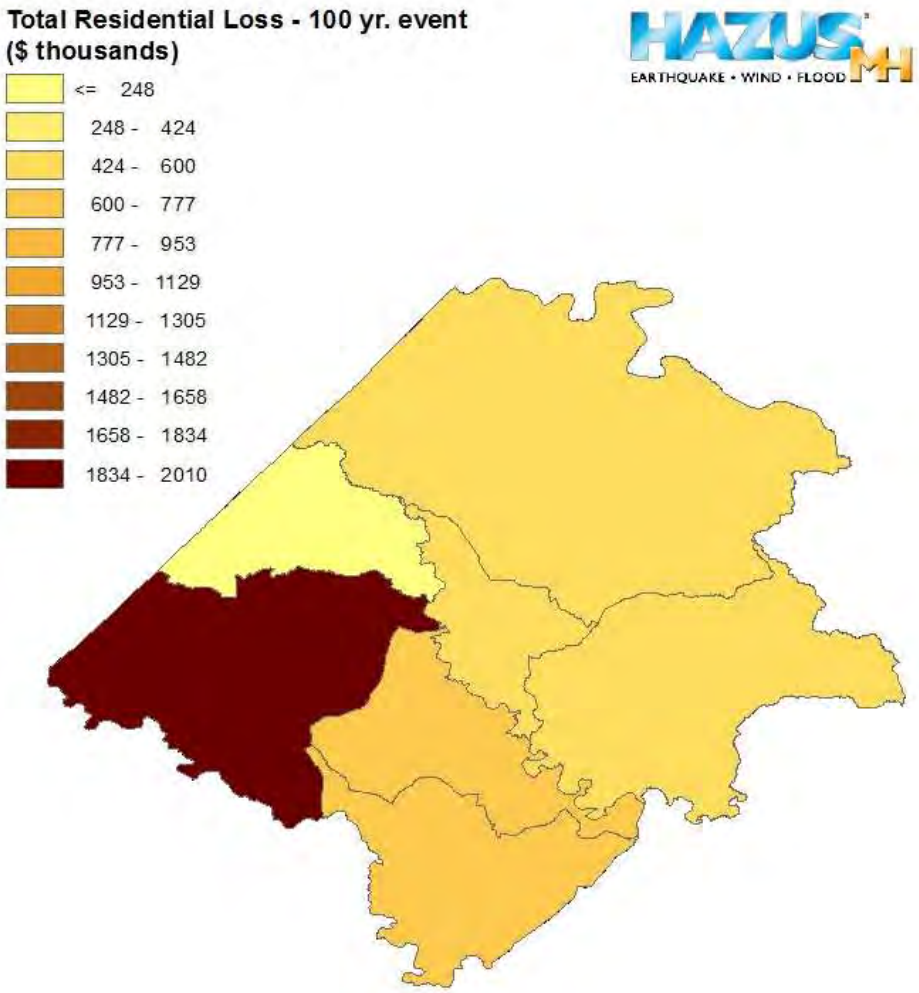
Wildfire Vulnerability

The Virginia Department of Forestry tracks wildfire events, including their location, size, frequency, and damages caused. Using this data, among other resources, VDOF classifies areas of the state based on their relative fire risk. This plan intersects wildfire area classifications generated by the VDOF with local parcel mapping and tax assessment data to determine the number of parcels located within high wildfire risk zones, and to quantify the value of real estate improvements (mainly buildings) that would be at risk in the event of a wildfire. individual counties and city that is encompassed by the GW Region provided hardcopy tax parcel information. Of particular importance to this analysis are the number of critical community facilities located within high wildfire risk areas. Government buildings, emergency facilities, schools, and other critical locations must be able to continue their function in the event of natural disasters. These facilities are best located in the least vulnerable areas of the locality, or should have contingency plans in place should they themselves be affected by natural hazards.

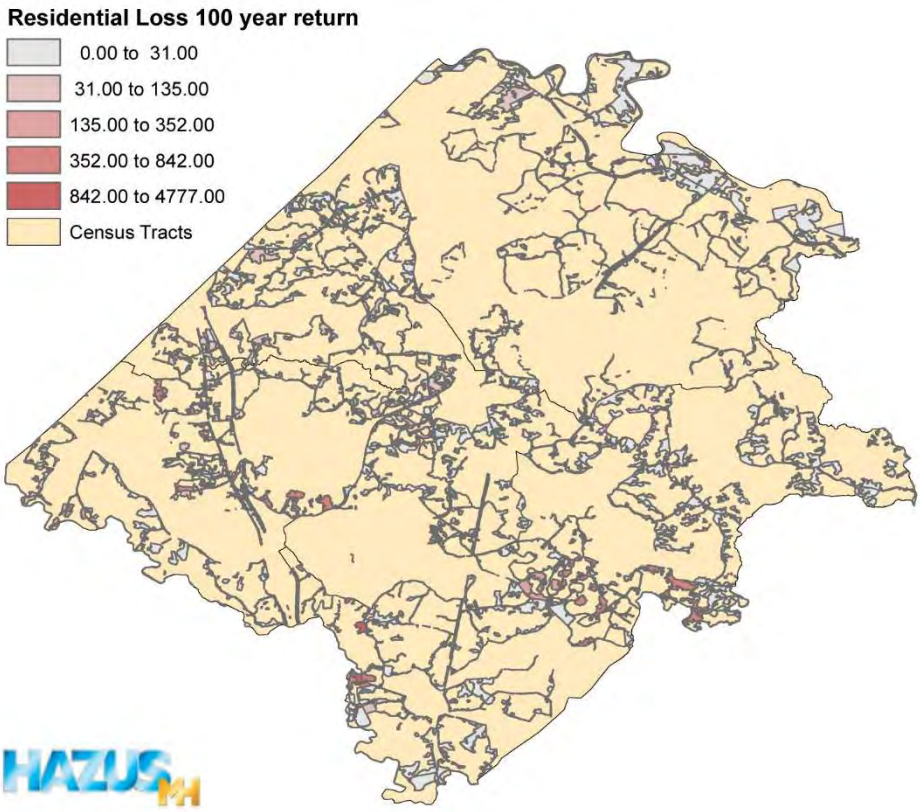
Wildfire Risk—Caroline County

Total No. Parcels	No. Parcels in High Wildfire Zone	Estimated at Risk Value
25,402	15,607	$1,516,776,500

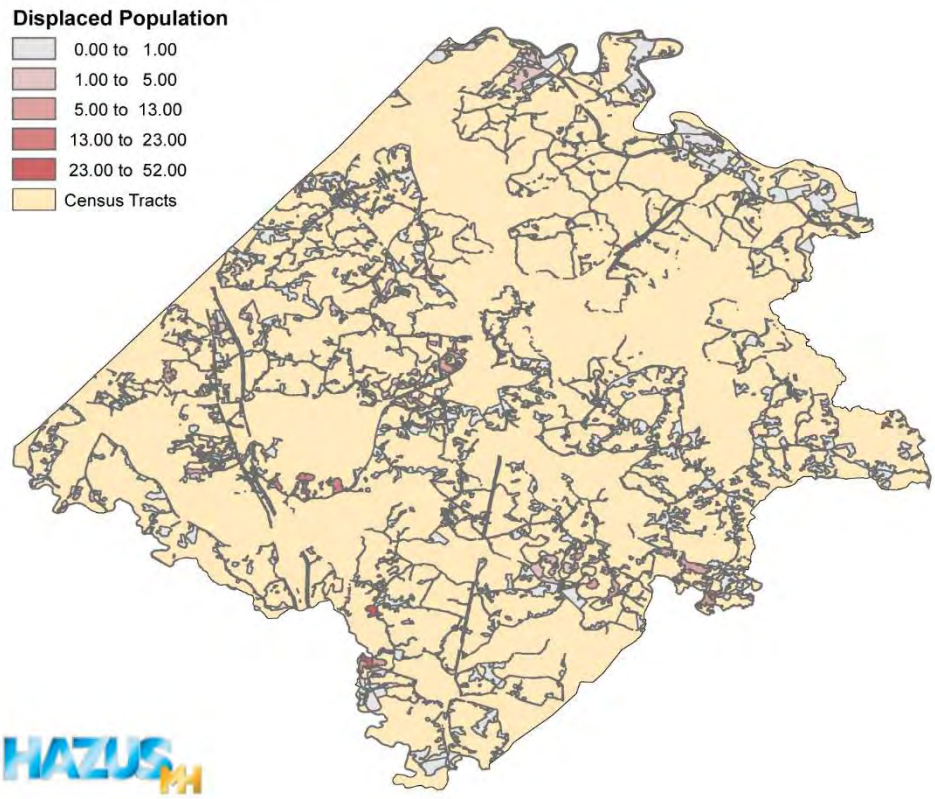
Source: Caroline County, Virginia Dept. of Forestry.



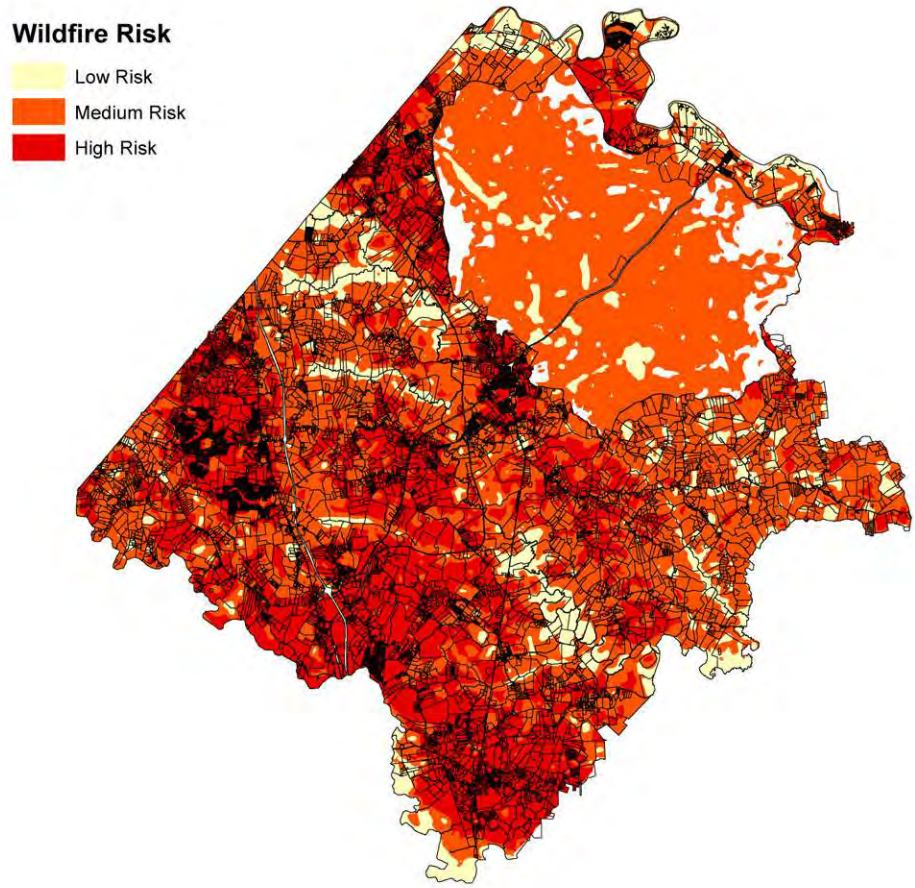
Residential Loss; 100-year Non-Rotational Wind Event; Caroline County. HAZUS.



Residential Loss; 100-year Flood Event; Caroline County. HAZUS.



Displaced Population; 100-year Flood Event; Caroline County. HAZUS.



Wildfire Risk; Caroline County. VDOF.

5.2.2 - City of Fredericksburg Vulnerability Assessment

Development Trends

The City of Fredericksburg's population increased from 19,279 in the 2000 census to 24,286 in 2010 census, a 26% increase, exceeded the 13% overall population growth of the State of Virginia for this period. The estimated population of Fredericksburg for the year 2015 was 28,118, representing an increase of nearly 16% over just 5 years.

As of 2016, there are 24,169 jobs in Fredericksburg. Unemployment in the County stands at 4.9% as of October 2016, trailing slightly the Virginia unemployment rate of 4.1%, but better than the national average of 4.7%.

Fredericksburg is an economic and employment hub for the region, drawing many shoppers and work commuters from nearby areas, including Spotsylvania and Stafford Counties. The Virginia Employment Commission 2014 civilian labor force estimate for the City was 14,572 with the resident employment rate of 13,896. The Virginia Economic Development Partnership Community Profile for the City of Fredericksburg shows that Health Care and Social Assistance sector is the largest employer in the City (5440), with the Accommodation and Food Services sector (4207) and the Retail Trade sector (3884) as the next largest categories for employment in the City.

Development trends were a significant consideration in the revision of the City of Fredericksburg Comprehensive Plan. The Plan was revised in 2015 and adopted by the Fredericksburg City Council as a to guide decision making for the physical development of the community, and focuses on balanced growth that respects the City's environmental and historic assets. The City can expect further growth pressure as state and national trends toward urban living continue. This pressure will face obstacles in the City's small land area and high rate of existing buildout.

As the City continues to development, areas for future growth should be weighed against areas vulnerable to natural hazards to determine ideal or priority growth areas. Hazard mitigation through land use planning can reduce the cost of future natural hazard events, both in risk to human life and in damage to public and private property.

Critical Facilities

In order to assess the vulnerability of a community to natural hazards, this plan provides an inventory of critical structures and facilities in the City of Fredericksburg. The critical facilities are the community's assets that are the most important or vital to emergency management. Critical facilities include:

- Emergency Operation Center (EOC);
- Emergency Communications Center (ECC) / 911;
- Law Enforcement Offices;
- Fire / Rescue Stations;
- Emergency Medical Services (EMS);
- Power;
- Communications;
- Water;
- Wastewater Treatment Plants (WWTP);

- Shelters; and
- Administration Buildings / Courthouse.

Critical facilities should be given special attention in preparing for a disaster because of their vital importance to maintaining citizen life, health, and safety during and directly after a disaster event.

Critical Facilities – City of Fredericksburg

Facility Name	City	Facility Type
Emergency Operation Center @ Police Headquarters – Backup Location @ Fredericksburg Fire Dept. Station 2	Fredericksburg	EOC
Executive Plaza Office Building	Fredericksburg	City Government and Fire Department Administration
Fredericksburg Police Headquarters; E-911 Center	Fredericksburg	Police Department; E-911 Center
Fredericksburg Sheriff; General District Court; Circuit Court	Fredericksburg	Police Department; Courts
Fredericksburg Fire Station 2	Fredericksburg	Fire Department
Fredericksburg Rescue Squad	Fredericksburg	Fire Department
Fredericksburg Fire Station 1	Fredericksburg	Fire Department
Juvenile and Domestic Relations Court	Fredericksburg	Court
Verizon	Fredericksburg	Communications
Courtland Water Pumping Station	Fredericksburg	Water Pumping Station
Powhatan Water Pumping Station	Fredericksburg	Water Pumping Station
Lafayette Blvd Pumping Station	Fredericksburg	Water Pumping Station
Moots Run Reservoir Water Treatment Plant	Spotsylvania	Water Treatment Plant
Normandy Village Sewage Pump Station	Fredericksburg	Sewage Pump Station
Bragg Hill Sewage Pump Station	Fredericksburg	Sewage Pump Station
Rt's 2 and 17 Area Sewage Pump Station	Fredericksburg	Sewage Pump Station
Snowden Sewage Pump Station	Fredericksburg	Sewage Pump Station
Caroline Street Sewage Pumping Station	Fredericksburg	Sewage Pumping Station
Fall Hill Sewage Pumping Station	Fredericksburg	Sewage Pumping Station
City of Fredericksburg Wastewater Treatment	Fredericksburg	Wastewater Treatment Plant
Hugh Mercer Elementary School	Fredericksburg	School / Shelter
James Monroe High School	Fredericksburg	School / Shelter
Walker-Grant Middle	Fredericksburg	School / Shelter
Lafayette Upper Elementary School	Fredericksburg	School/Shelter

Facility Name	City	Facility Type
City Hall	Fredericksburg	Administration
Additional significant structures		
Mary Washington Hospital	Fredericksburg	Hospital
National Guard Armory	Fredericksburg	Military
FBI Field Office (local)	Fredericksburg	Federal Government
University of Mary Washington	Fredericksburg	University

Source: Data provided by the City of Fredericksburg

Non-Rotational Wind Vulnerability

The HAZUS analysis tool was used to assess the vulnerability of the locality to hurricane wind hazards. Options provided by HAZUS for this analysis are the probabilistic and deterministic methods. The probabilistic scenario is the default option and relies on a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

The probabilistic wind analysis was chosen because it provides the statistical probability for a range of hurricane events and presents a comparison of these events. The probabilistic analysis was used to generate structural loss estimations for hurricane events with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. The recurrence interval is the average interval of time within which the given hurricane event will be equaled or exceeded once.

Because residential structures comprise a significantly large percentage of the occupancy classification within all subject localities, these data are presented in below.

Hurricane Risk – City of Fredericksburg. Summary of Probability Analysis – Residential Structures

Return Period	Residential Building Damage			
	Minor Damage	Moderate Damage	Severe Damage	Total Destruction
10-year	0	0	0	0
20-year	0	0	0	0
50-year	6	0	0	0
100-year	12	0	0	0
200-year	37	3	0	0
500-year	165	18	0	0
1000-year	319	43	0	0

Source: HAZUS, 2016

Hurricane Risk – City of Fredericksburg. Summary of Probability Analysis – Economic Loss

Return Period	Property Damage – Capital Loss		Business Interruption
	Residential ($)	Total ($)	Income Loss ($)
10-year	0	0	0
20-year	0	0	0
50-year	31,000	31,000	0
100-year	901,000	1,023,000	1,000
200-year	2,540,000	2,662,000	13,000
500-year	7,479,000	7,892,000	424,000
1000-year	11,931,000	12,833,000	736,000

Source: HAZUS, 2016

Flooding Vulnerability

Repetitive Loss Properties

The City of Fredericksburg includes 178 properties enrolled in the National Flood Insurance Program (NFIP), of which four are classified as Repetitive Loss properties. All four of these classified Repetitive Loss properties are residential properties. A Repetitive Loss property is defined as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP over any rolling 10-year period since 1978. A Severe Repetitive Loss property is defined as any insurable building for which four or more claims of more than $1,000 were paid by the NFIP over any rolling 10-year period since 1978. Repetitive Loss properties strain the resources of the NFIP, while remaining at risk for future property damage, injury, or loss of life. In these cases, the primary objective of the NFIP, and of this plan, is to promote permanent solutions to repetitive flooding problems, either through structural measures that reduce or eliminate the flooding risk, or by removal of structures within high risk flood areas.

HAZUS Flood Analysis

The HAZUS analysis tool was used to assess the structural and economic impact of predicted flood events on the locality. Hazard type options provided by HAZUS for flood analysis are the riverine, coastal, and combined riverine and coastal scenarios. The necessary scenario for any given situation depends upon the geography of the region. If the area is inland with a stream hydrology, then the riverine scenario should be used. If however, the area is along the coast then either the riverine and coastal, or coastal scenario should be used.

The riverine analysis was chosen for Fredericksburg. This scenario provides the statistical probability for a range of flood events and presents a comparison of those events. The riverine analysis was used to generate structural loss estimations, agricultural loss estimations, and shelter requirements for flood events with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, and 500-year. The recurrence interval is the average interval of time within which the given flood event will be equaled or exceeded once. The data included below represents the likely effects on the 100-year flood event on the community.

Flood Risk – City of Fredericksburg

Occupancy Type	Dollar Exposure (replacement value $)	Percent of total
Residential	$303,673,000	70.1%
Commercial	$94,879,000	21.9%
Industrial	$12,473,000	2.9%
Agricultural	$884,000	0.2%
Religion	$11,049,000	2.6%
Government	$10,167,000	2.3%
Education	$95,000	0.0%
TOTAL	**$433,220,000**	**100.0%**

Source: HAZUS, 2016

In addition to the above cited economic impacts to local structures, HAZUS estimates the displacement of 167 households as the result of a hypothetical 100-year flood event, with 390 people seeking emergency shelter within the community. Damage in the above-forecast amounts to local structures would additionally produce 4,531 tons of flood related building debris.

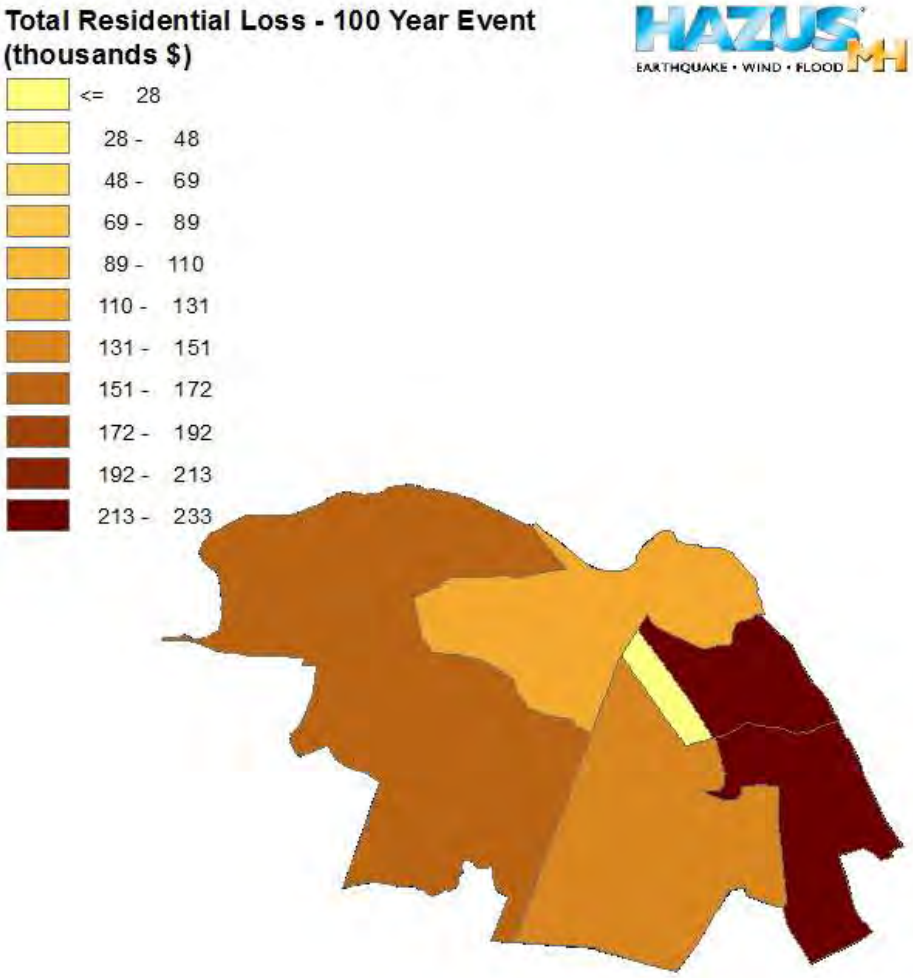
Wildfire Vulnerability

The Virginia Department of Forestry tracks wildfire events, including their location, size, frequency, and damages caused. Using this data, among other resources, VDOF classifies areas of the state based on their relative fire risk. This plan intersects wildfire area classifications generated by the VDOF with local parcel mapping and tax assessment data to determine the number of parcels located within high wildfire risk zones, and to quantify the value of real estate improvements (mainly buildings) that would be at risk in the event of a wildfire. individual counties and city that is encompassed by the GW Region provided hardcopy tax parcel information. Of particular importance to this analysis are the number of critical community facilities located within high wildfire risk areas. Government buildings, emergency facilities, schools, and other critical locations must be able to continue their function in the event of natural disasters. These facilities are best located in the least vulnerable areas of the locality, or should have contingency plans in place should they themselves be affected by natural hazards.

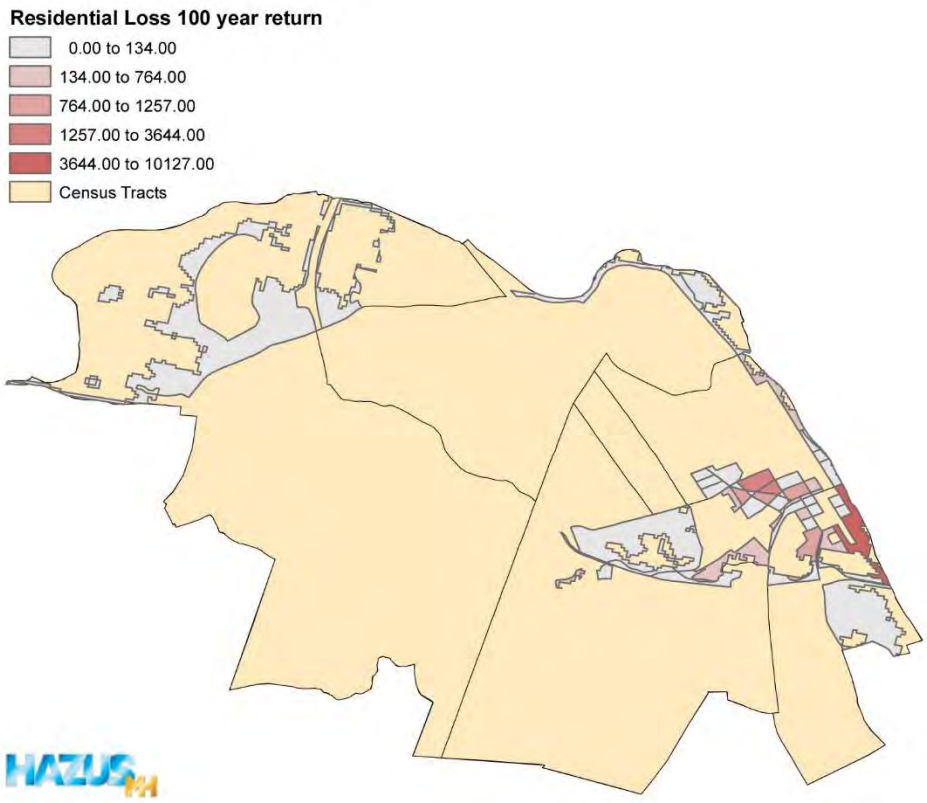
Wildfire Risk—City of Fredericksburg

Total No. Parcels	No. Parcels in High Wildfire Zone	Estimated at Risk Value
8,432	1,454	$503,429,300

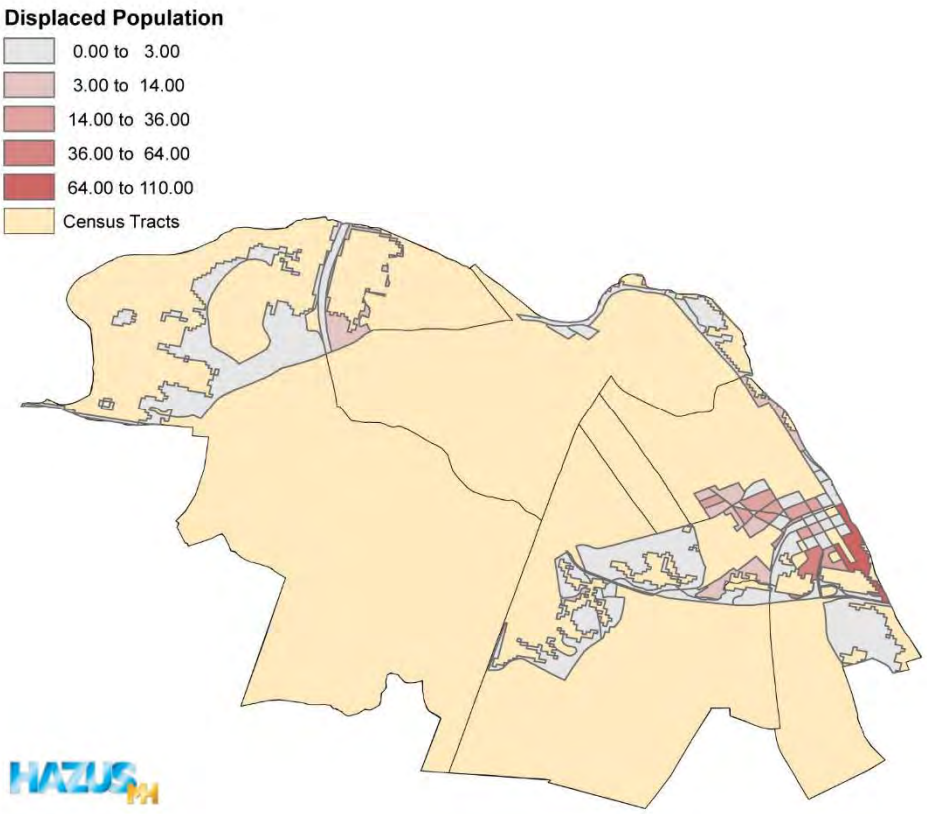
Source: City of Fredericksburg, Virginia Dept. of Forestry.



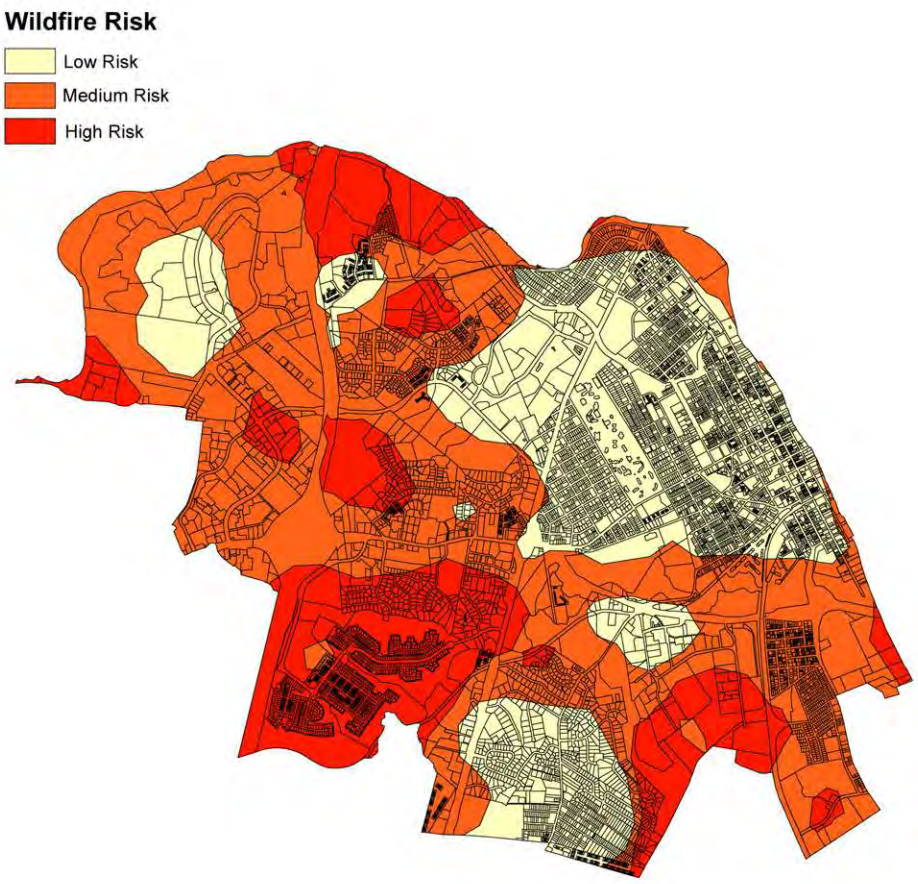
Residential Loss; 100-year Non-Rotational Wind Event; City of Fredericksburg. HAZUS.



Residential Loss; 100-year Flood Event; City of Fredericksburg. HAZUS.



Displaced Population; 100-year Flood Event; City of Fredericksburg. HAZUS.



Wildfire Risk; City of Fredericksburg. VDOF.

5.2.3 - King George County Vulnerability Assessment

Development Trends

King George County's population increased from 16,803 in the 2000 census to 23,584 in 2010 census, a 40% increase. This growth far exceeded the 13% overall population growth of the State of Virginia for this period. The estimated population of King George County for the year 2015 was 25,515. Population projections maintained by the Virginia Employment Commission call for continued County growth, with the population reaching 27,109 by 2020 and climb further to 29,997 by 2030.

As of 2016, there are 11,463 jobs in King George, with the federal government a major employer. Unemployment in the County stands at 4.1% as of October 2016, matching the rate for the State of Virginia as a whole, and beating the national average of 4.7%. Many residents of King George commute to locations outside of the County for work. The County's major employer is the United States Navy base at Dahlgren. Other large employers include Computer Sciences Corporation and Synetics, Inc. (Source: Virginia Economic Development Partnership). There is a large retail development in the Dahlgren Area including a Walmart, University of Mary Washington campus, and several hotels.

The King George County Comprehensive Plan promotes the goals of business recruitment, job creation, business retention, and marketing in King George County. A feature of the Plan's Land Use Strategy is the desire to "encourage the creation of an environment to attract businesses and employees for the public and private sectors." However, the County also desires to protect its rural areas, even as population, jobs, and the local economy grow. King George navigates this balance by designating specific planning areas to be targets for future growth. Designated settlement areas are those that feature public utility systems, and include the areas of the Courthouse, Dahlgren, Fairview Beach, Hopyard, and Oakland Park.

As the County continues to development, areas for future growth should be weighed against areas vulnerable to natural hazards to determine ideal or priority growth areas. Hazard mitigation through land use planning can reduce the cost of future natural hazard events, both in risk to human life and in damage to public and private property.

Critical Facilities

In order to assess the vulnerability of a community to natural hazards, this plan provides an inventory of critical structures and facilities in King George County. The critical facilities are the community's assets that are the most important or vital to emergency management. Critical facilities include:

- Emergency Operation Center (EOC);
- Emergency Communications Center (ECC) / 911;
- Law Enforcement Offices;
- Fire / Rescue Stations;
- Emergency Medical Services (EMS);
- Power;
- Communications;
- Water;
- Wastewater Treatment Plants (WWTP);
- Shelters; and

- Administration Buildings / Courthouse.

Critical facilities should be given special attention in preparing for a disaster because of their vital importance to maintaining citizen life, health, and safety during and directly after a disaster event.

Critical Facilities – King George County

Facility Name	Location	Facility Type
King Georges Sheriff's Office	King George	ECC
King George Fire & Rescue Company 1	King George	EOC/Fire Department
King George Fire & Rescue Company 2	King George	Fire Department
King George Fire & Rescue Company 3	King George	Fire Department
King George Fire & Rescue Station 2	King George	Rescue Station
Dahlgren WWTP	King George	Waste Treatment
Fairview Beach WWTP	King George	Waste Treatment
Hopyard Farm WWTP	King George	Waste Treatment
Oakland Park WWTP	King George	Waste Treatment
Purkins Corner WWTP	King George	Waste Treatment
Presidential Lakes WWTP	King George	Waste Treatment
King George High School	King George	Schools/Shelter Sites
King George Middle School	King George	Schools/Shelter Sites
King George Elementary School	King George	Schools/Shelter Sites
Potomac Elementary School	King George	Schools/Shelter Sites
King George Citizens Center	King George	Schools/Shelter Sites
Sealston Elementary	King George	Schools/Shelter Sites
Administration Center	King George	Administration
King George Courthouse Complex	King George	Administration
Service Authority Office	King George	Administration
King George Animal Shelter	King George	Administration
King George Sheriff's Office	King George	Administration/Sheriff's Office
King George Library	King George	Administration
Additional significant structures		
King George County School Bus Garage	King George	School Administration
Harry Nice Memorial Bridge	King George	Bridge
Rappahannock River Bridge	King George	Bridge
Williams Creek Bridge	King George	Bridge
Muddy Creek Bridge	King George	Bridge
Machadoc Creek Bridge	King George	Bridge
Machadoc Creek Bridge	King George	Bridge

Facility Name	Location	Facility Type

Source: Data provided by the King George Office of Emergency Management.

Non-Rotational Wind Vulnerability

The HAZUS analysis tool was used to assess the vulnerability of the locality to hurricane wind hazards. Options provided by HAZUS for this analysis are the probabilistic and deterministic methods. The probabilistic scenario is the default option and relies on a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

The probabilistic wind analysis was chosen because it provides the statistical probability for a range of hurricane events and presents a comparison of these events. The probabilistic analysis was used to generate structural loss estimations for hurricane events with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. The recurrence interval is the average interval of time within which the given hurricane event will be equaled or exceeded once.

Because residential structures comprise a significantly large percentage of the occupancy classification within all subject localities, these data are presented in below.

Hurricane Risk – King George County. Summary of Probability Analysis – Residential Structures

Return Period	Residential Building Damage			
	Minor Damage	Moderate Damage	Severe Damage	Total Destruction
10-year	0	0	0	0
20-year	0	0	0	0
50-year	2	0	0	0
100-year	9	0	0	0
200-year	51	1	0	0
500-year	197	10	0	0
1000-year	488	30	0	0

Source: HAZUS, 2016

Hurricane Risk – King George County. Summary of Probability Analysis – Economic Loss

Return Period	Property Damage – Capital Loss		Business Interruption
	Residential ($)	Total ($)	Income Loss ($)
10-year	0	0	0
20-year	0	70,000	0

Return Period	Property Damage – Capital Loss		Business Interruption
	Residential ($)	Total ($)	Income Loss ($)
50-year	671,000	671,000	0
100-year	2,590,000	2,623,000	0
200-year	6,732,000	6,775,000	8,000
500-year	14,482,000	14,622,000	296,000
1000-year	22,470,000	22,849,000	621,000

Source: HAZUS, 2016

Flooding Vulnerability

Repetitive Loss Properties

King George County includes 79 properties enrolled in the National Flood Insurance Program (NFIP). At this time, none of these properties is classified as a Repetitive Loss property. A Repetitive Loss property is defined as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP over any rolling 10-year period since 1978. A Severe Repetitive Loss property is defined as any insurable building for which four or more claims of more than $1,000 were paid by the NFIP over any rolling 10-year period since 1978. Repetitive Loss properties strain the resources of the NFIP, while remaining at risk for future property damage, injury, or loss of life. In these cases, the primary objective of the NFIP, and of this plan, is to promote permanent solutions to repetitive flooding problems, either through structural measures that reduce or eliminate the flooding risk, or by removal of structures within high risk flood areas.

HAZUS Flood Analysis

The HAZUS analysis tool was used to assess the structural and economic impact of predicted flood events on the locality. Hazard type options provided by HAZUS for flood analysis are the riverine, coastal, and combined riverine and coastal scenarios. The necessary scenario for any given situation depends upon the geography of the region. If the area is inland with a stream hydrology, then the riverine scenario should be used. If however, the area is along the coast then either the riverine and coastal, or coastal scenario should be used.

The riverine analysis was chosen for King George County. This scenario provides the statistical probability for a range of flood events and presents a comparison of those events. The riverine analysis was used to generate structural loss estimations, agricultural loss estimations, and shelter requirements for flood events with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, and 500-year. The recurrence interval is the average interval of time within which the given flood event will be equaled or exceeded once. The data included below represents the likely effects on the 100-year flood event on the community.

Flood Risk – King George County

Occupancy Type	Dollar Exposure (replacement value $)	Percent of total
Residential	$786,275,000	84.9%
Commercial	$98,264,000	10.6%
Industrial	$12,787,000	1.4%
Agricultural	$2,842,000	0.3%
Religion	$11,566,000	1.2%
Government	$10,003,000	1.1%
Education	$4,879,000	0.5%
TOTAL	**$926,616,000**	**100.0%**

Source: HAZUS, 2016

In addition to the above cited economic impacts to local structures, HAZUS estimates the displacement of 49 households as the result of a hypothetical 100-year flood event, with 20 people seeking emergency shelter within the community.

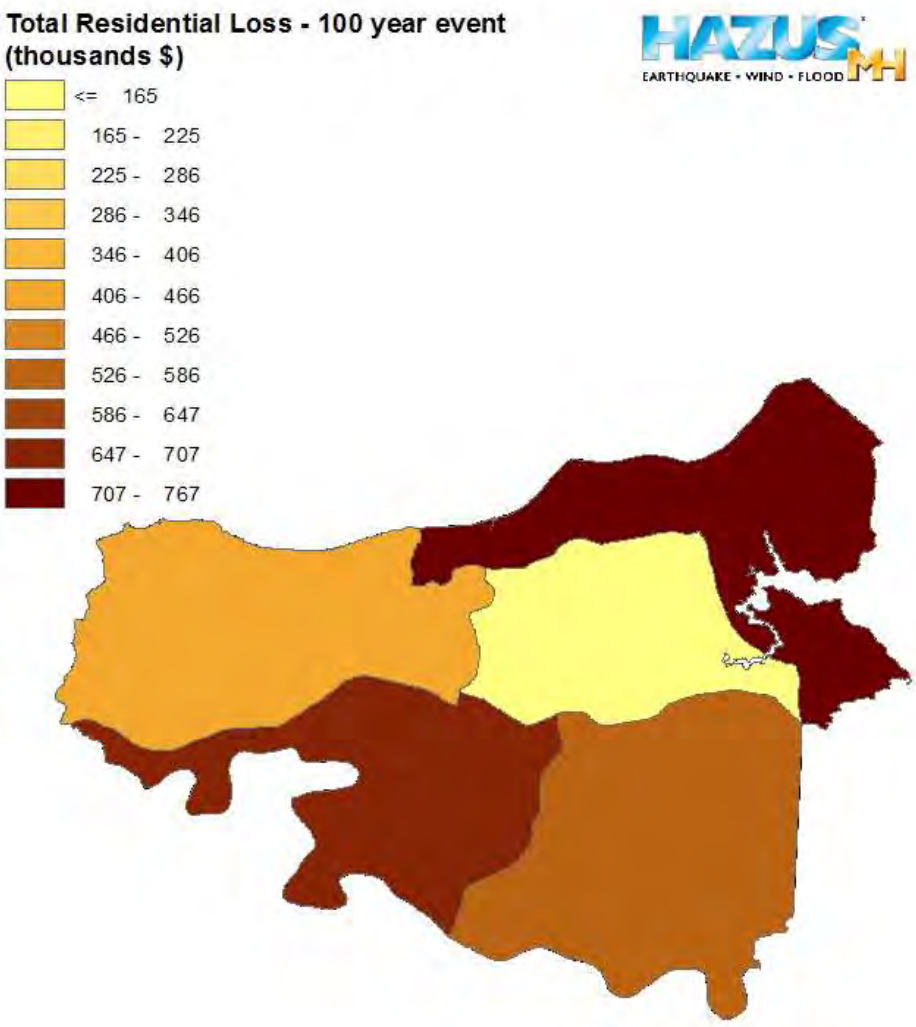
Wildfire Vulnerability

The Virginia Department of Forestry tracks wildfire events, including their location, size, frequency, and damages caused. Using this data, among other resources, VDOF classifies areas of the state based on their relative fire risk. This plan intersects wildfire area classifications generated by the VDOF with local parcel mapping and tax assessment data to determine the number of parcels located within high wildfire risk zones, and to quantify the value of real estate improvements (mainly buildings) that would be at risk in the event of a wildfire. individual counties and city that is encompassed by the GW Region provided hardcopy tax parcel information. Of particular importance to this analysis are the number of critical community facilities located within high wildfire risk areas. Government buildings, emergency facilities, schools, and other critical locations must be able to continue their function in the event of natural disasters. These facilities are best located in the least vulnerable areas of the locality, or should have contingency plans in place should they themselves be affected by natural hazards.

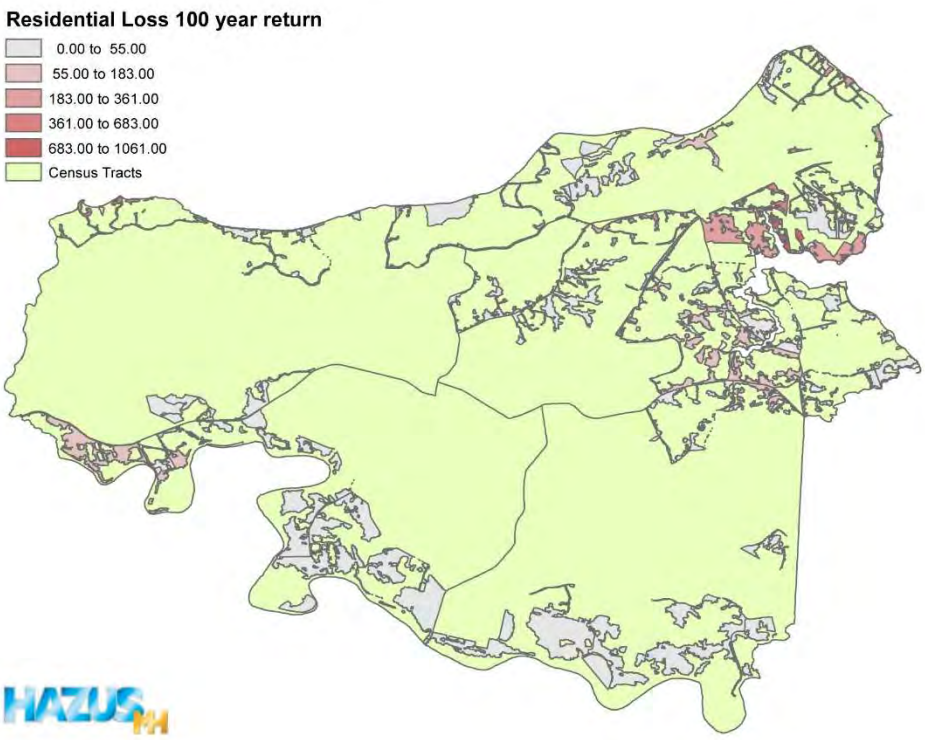
Wildfire Risk—King George County

Total No. Parcels	No. Parcels in High Wildfire Zone	Estimated at Risk Value
13,889	6,935	$938,925,400

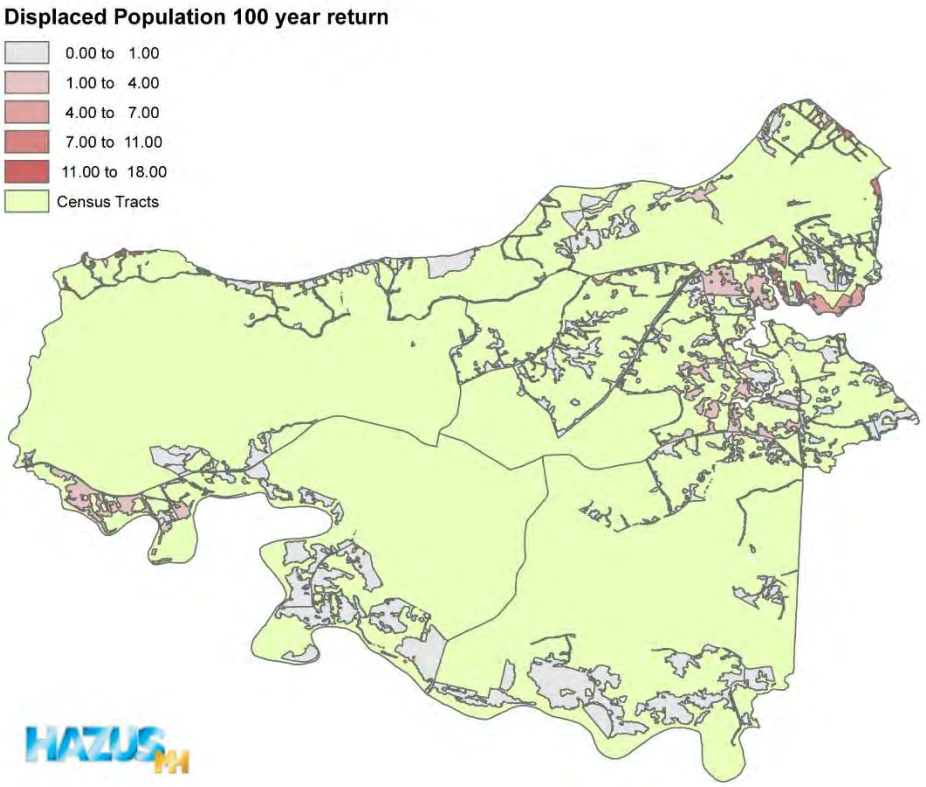
Source: King George County, Virginia Dept. of Forestry.



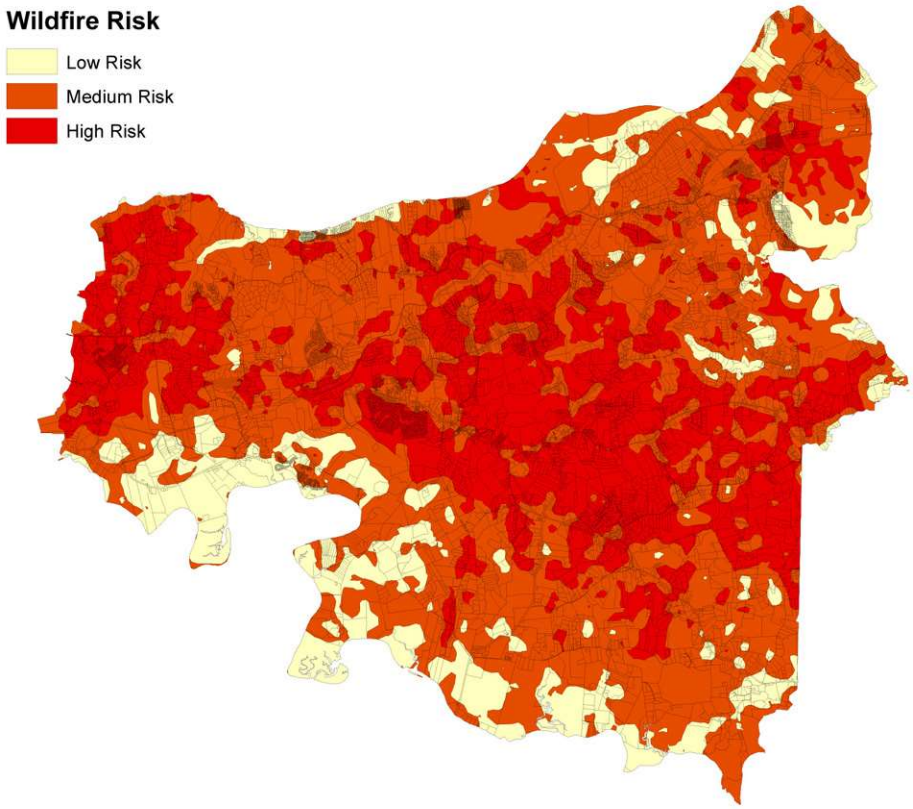
Residential Loss; 100-year Non-Rotational Wind Event; King George County. HAZUS.



Residential Loss; 100-year Flood Event; King George County. HAZUS.



Displaced Population; 100-year Flood Event; King George County. HAZUS.



Wildfire Risk; King George County. VDOF.

5.2.4 - Spotsylvania County Vulnerability Assessment

Development Trends

Spotsylvania County's population increased from 90,395 in the 2000 census to 122,397 in 2010 census, a 35.4% increase. This growth far exceeded the 13% overall population growth of the State of Virginia for this period. The estimated population of Spotsylvania County for the year 2015 was 130,475. Population projections maintained by the Virginia Employment Commission call for County population to continue its rapid growth, reaching 166,236 by 2020 and climbing further to 223,917 by 2030.

Spotsylvania County's close proximity to Washington, D.C., Richmond, Va, and Interstate 95 have led to its rapid growth in population and economic activity. The county's development trend is based on its technology and manufacturing industries and suburban housing for Washington D.C. and Northern Virginia commuters. Since 2012, Spotsylvania County has seen a rise in applications and approvals for large mixed use developments, higher density developments meant to provide a wide array of housing types amongst a mix of uses within walkable distance where citizens can live, work, and shop. Recent rezoning activity for mixed use communities include Jackson Village, a 241-acre mixed-use project which is envisioned to have up to 298,000 square feet of commercial space and 2,270 homes; and Alexander's Crossing, a 2,607-home mixed use development with up to 1.6 million square feet of commercial space.

As of 2016, there are 35,167 jobs in Spotsylvania, including a strong mix of retail, healthcare, and government sectors. The County continues to target business sectors in healthcare, manufacturing, professional services (high tech/IT/defense) and tourism. Unemployment in the County stands at 4.2% as of October 2016, trailing only slightly the Virginia unemployment rate of 4.1%, but better than the national average of 4.7%. While many residents of Spotsylvania are employed, a large number commute to locations outside of the County for work, including Fredericksburg and various locations in the Washington D.C. metropolitan area.

Major employers within Spotsylvania County include: HCA Virginia Health System (Hospital 250-499 employees): CVS Pharmacy (distribution warehouse, 250-500 employees); Germanna Community College (Education, 250-499 employees); Rappahannock Goodwill Industries (Rehabilitation Services, 250-499 employees); Rappahannock Electric Cooperative (Electric Supplier, 100-249 employees); EOIR Technologies (Gov't Contractor, 100-249 employees); Kaeser Compressors (Air Compressors, 100-249 employees); Simmons Manufacturing (Matresses, 100-249 employees); Trussway Manufacturing (Wood Trusses, 100-249 employees); OFIC North America (Vinyl Building Panels, 100-249 employees); PAE (Gov't Contractor, 100-249 employees). An additional major employer within the County was announced in 2015 with the entrance of European grocer, Lidl, to the United States market. In addition to two retail store sites within the County, Lidl is constructing a 900,000 square foot distribution center off Smith Station Road.

As the County continues to development, areas for future growth should be weighed against areas vulnerable to natural hazards to determine ideal or priority growth areas. Hazard mitigation through land use planning can reduce the cost of future natural hazard events, both in risk to human life and in damage to public and private property.

Critical Facilities

In order to assess the vulnerability of a community to natural hazards, this plan provides an inventory of critical structures and facilities in Spotsylvania County. The critical facilities are the community's assets that are the most important or vital to emergency management. Critical facilities include:

- Emergency Operation Center (EOC);
- Emergency Communications Center (ECC) / 911;
- Law Enforcement Offices;
- Fire / Rescue Stations;
- Emergency Medical Services (EMS);
- Power;
- Communications;
- Water;
- Wastewater Treatment Plants (WWTP);
- Shelters; and
- Administration Buildings / Courthouse.

Critical facilities should be given special attention in preparing for a disaster because of their vital importance to maintaining citizen life, health, and safety during and directly after a disaster event.

Critical Facilities – Spotsylvania County

Facility Name	Location	Facility Type
Brokenburg Fire & Rescue 2	Spotsylvania	Fire/EMS
Partlow Fire Company 3	Spotsylvania	Fire
5-Mile Fork Fire Company 5 & Rescue	Spotsylvania	Fire/EMS
Salem Church Road Fire Company & Rescue Station 6	Spotsylvania	Fire/EMS
Wilderness Fire Company & Rescue Station 7	Spotsylvania	Fire/EMS
Thornburg Fire Company & Rescue Station 8	Spotsylvania	Fire/EMS
Belmont Fire Company & Rescue Station 9	Spotsylvania	Fire/EMS
Fire Company & Rescue Station 1	Spotsylvania	Fire/EMS
Fire Company & Rescue Station 4	Fredericksburg	Fire/EMS
Salem Fields Fire Company & Rescue Station 10	Fredericksburg	Fire/EMS
Fire Company & Rescue Station 11	Fredericksburg	Fire/EMS
Ni River Water Treatment Plant	Spotsylvania	Potable Treatment
Motts Run Water Treatment Plant	Fredericksburg	Potable Treatment
FMC Wastewater Treatment Plant	Fredericksburg	Water Treatment
Massaponax Wastewater Treatment Plant	Fredericksburg	Water Treatment
Stoneybrook Wastewater Treatment Plant	Fredericksburg	Water Treatment
Thornburg Wastewater Treatment Plant	Woodford	Water Treatment
County Courthouse	Spotsylvania	Administration
Holbert Building	Spotsylvania	Local Government
Marshall Center	Spotsylvania	Local Government
Merchant Square Bldg.	Spotsylvania	Local Government
Animal Control Office	Fredericksburg	Local Government
Joint Fleet Maintenance Facility	Spotsylvania	Local Government
Utilities Administration Office	Fredericksburg	Local Government
Voter Registration	Spotsylvania	Local Government
911/EOC/Sheriff/Fire Administration	Spotsylvania	Public Safety Bldg/911/EOC

Facility Name	Location	Facility Type
School Transportation Office	Spotsylvania	School/Support Facility
Battlefield Elementary	Fredericksburg	School/ Shelter Site
Battlefield Middle	Fredericksburg	School/Shelter Site
Berkeley Elementary	Spotsylvania	School/Shelter Site
Brock Road Elementary	Spotsylvania	School/Shelter Site
Career and Technical Center High	Spotsylvania	School/Shelter Site
Cedar Forest Elementary	Fredericksburg	School/ Shelter Site
Chancellor Elementary	Fredericksburg	School/Shelter Site
Chancellor High	Fredericksburg	School/Shelter Site
Chancellor Middle	Fredericksburg	School/Shelter Site
Courthouse Road Elementary	Spotsylvania	School/Shelter Site
Courtland Elementary	Spotsylvania	School/Shelter Site
Courtland High	Spotsylvania	School/Shelter Site
Freedom Middle	Fredericksburg	School/Shelter Site
Harrison Road Elementary	Fredericksburg	School/Shelter Site
Lee Hill Elementary	Fredericksburg	School/Shelter Site
Livingston Elementary	Spotsylvania	School/Shelter Site
Massaponax High	Fredericksburg	School/Shelter Site
Ni River Middle	Spotsylvania	School/Shelter Site
Parkside Elementary	Fredericksburg	School/Shelter Site
Post Oak Middle	Spotsylvania	School/Shelter Site
Riverbend High	Fredericksburg	School/Shelter Site
Riverview Elementary	Spotsylvania	School/Shelter Site
Robert E. Lee Elementary	Spotsylvania	School/Shelter Site
Salem Elementary	Fredericksburg	School/Shelter Site
Smith Station Elementary	Fredericksburg	School/Shelter Site
Spotswood Elementary	Fredericksburg	School/Shelter Site
Spotsylvania High	Spotsylvania	School/Shelter Site
Spotsylvania Middle	Spotsylvania	School/Shelter Site
Thornburg Middle	Spotsylvania	School/Shelter Site
Wilderness Elementary	Spotsylvania	School/Shelter Site

Source: Data provided by the Spotsylvania Fire, Rescue, and Emergency Management

Non-Rotational Wind Vulnerability

The HAZUS analysis tool was used to assess the vulnerability of the locality to hurricane wind hazards. Options provided by HAZUS for this analysis are the probabilistic and deterministic methods. The probabilistic scenario is the default option and relies on a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

The probabilistic wind analysis was chosen because it provides the statistical probability for a range of hurricane events and presents a comparison of these events. The probabilistic analysis was used to generate structural loss estimations for hurricane events with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. The recurrence interval is the average interval of time within which the given hurricane event will be equaled or exceeded once.

Because residential structures comprise a significantly large percentage of the occupancy classification within all subject localities, these data are presented in below.

Hurricane Risk – Spotsylvania County. Summary of Probability Analysis – Residential Structures

Return Period	Residential Building Damage			
	Minor Damage	Moderate Damage	Severe Damage	Total Destruction
10-year	0	0	0	0
20-year	0	0	0	0
50-year	5	0	0	0
100-year	24	0	0	0
200-year	133	2	0	0
500-year	812	29	0	0
1000-year	1,891	107	0	1

Source: HAZUS, 2016

Hurricane Risk – Spotsylvania County. Summary of Probability Analysis – Economic Loss

Return Period	Property Damage – Capital Loss		Business Interruption
	Residential ($)	Total ($)	Income Loss ($)
10-year	0	0	0
20-year	0	0	0
50-year	2,914,000	2,914,000	0
100-year	11,892,000	12,061,000	1,000
200-year	29,519,000	29,719,000	11,000
500-year	75,741,000	76,275,000	880,000
1000-year	113,577,000	115,071,000	2,552,000

Source: HAZUS, 2016

Flooding Vulnerability

Repetitive Loss Properties

Spotsylvania County includes 304 properties enrolled in the National Flood Insurance Program (NFIP). At this time, none of these properties is classified as a Repetitive Loss property. A Repetitive Loss property is defined as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP over any rolling 10-year period since 1978. A Severe Repetitive Loss property is defined as any insurable building for which four or more claims of more than $1,000 were paid by the NFIP over any rolling 10-year period since 1978. Repetitive Loss properties strain the resources of the NFIP, while

remaining at risk for future property damage, injury, or loss of life. In these cases, the primary objective of the NFIP, and of this plan, is to promote permanent solutions to repetitive flooding problems, either through structural measures that reduce or eliminate the flooding risk, or by removal of structures within high risk flood areas.

HAZUS Flood Analysis

The HAZUS analysis tool was used to assess the structural and economic impact of predicted flood events on the locality. Hazard type options provided by HAZUS for flood analysis are the riverine, coastal, and combined riverine and coastal scenarios. The necessary scenario for any given situation depends upon the geography of the region. If the area is inland with a stream hydrology, then the riverine scenario should be used. If however, the area is along the coast then either the riverine and coastal, or coastal scenario should be used.

The riverine analysis was chosen for Spotsylvania County. This scenario provides the statistical probability for a range of flood events and presents a comparison of those events. The riverine analysis was used to generate structural loss estimations, agricultural loss estimations, and shelter requirements for flood events with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, and 500-year. The recurrence interval is the average interval of time within which the given flood event will be equaled or exceeded once. The data included below represents the likely effects on the 100-year flood event on the community.

Flood Risk – Spotsylvania County

Occupancy Type	Dollar Exposure (replacement value $)	Percent of total
Residential	$3,344,089,000	87.4%
Commercial	$324,231,000	8.5%
Industrial	$59,541,000	1.6%
Agricultural	$7,952,000	0.2%
Religion	$39,178,000	1.0%
Government	$7,863,000	0.2%
Education	$41,526,000	1.1%
TOTAL	**$3,824,380,000**	**100.0%**

Source: HAZUS, 2016

In addition to the above cited economic impacts to local structures, HAZUS estimates the displacement of 344 households as the result of a hypothetical 100-year flood event, with 585 people seeking emergency shelter within the community.

Wildfire Vulnerability

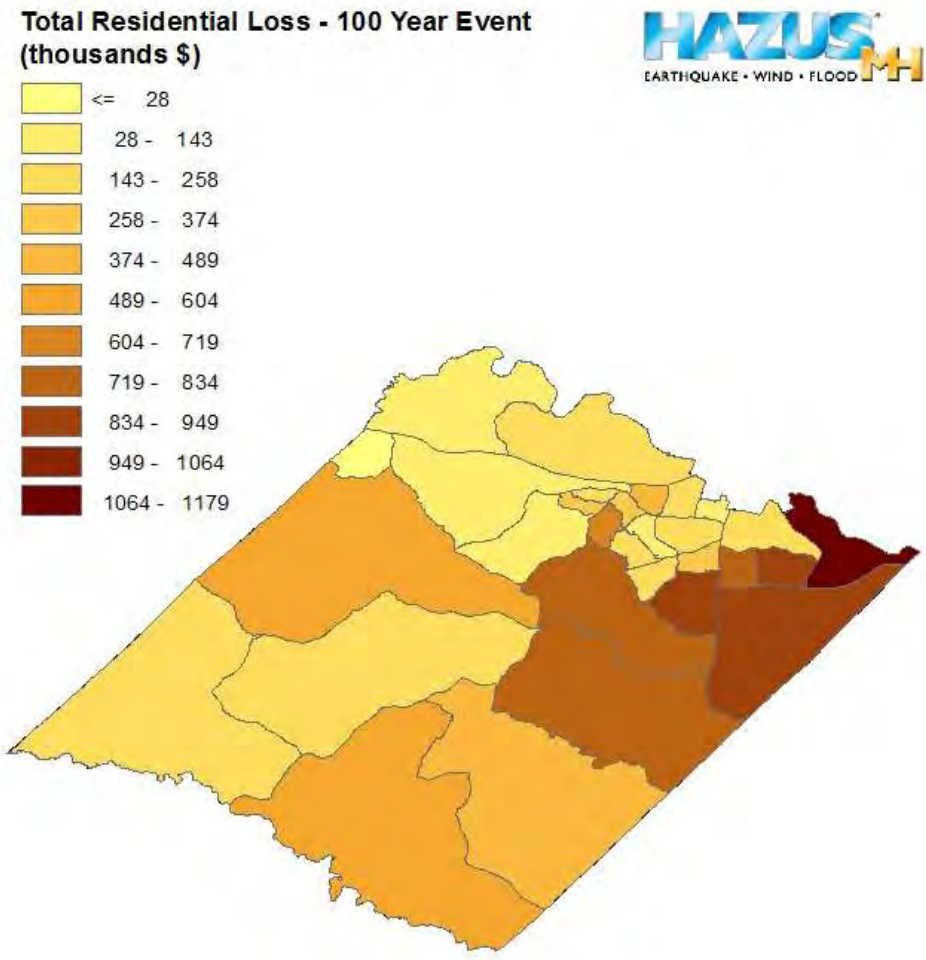
The Virginia Department of Forestry tracks wildfire events, including their location, size, frequency, and damages caused. Using this data, among other resources, VDOF classifies areas of the state based on

their relative fire risk. This plan intersects wildfire area classifications generated by the VDOF with local parcel mapping and tax assessment data to determine the number of parcels located within high wildfire risk zones, and to quantify the value of real estate improvements (mainly buildings) that would be at risk in the event of a wildfire. individual counties and city that is encompassed by the GW Region provided hardcopy tax parcel information. Of particular importance to this analysis are the number of critical community facilities located within high wildfire risk areas. Government buildings, emergency facilities, schools, and other critical locations must be able to continue their function in the event of natural disasters. These facilities are best located in the least vulnerable areas of the locality, or should have contingency plans in place should they themselves be affected by natural hazards.

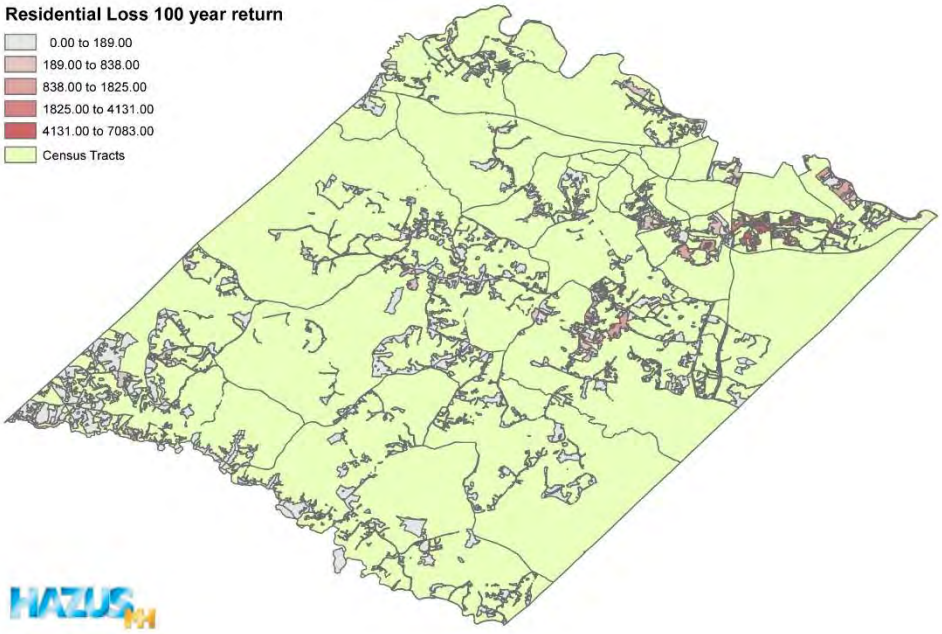
Wildfire Risk—Spotsylvania County

Total No. Parcels	No. Parcels in High Wildfire Zone	Estimated at Risk Value
63,817	43,267	$3,489,403,800

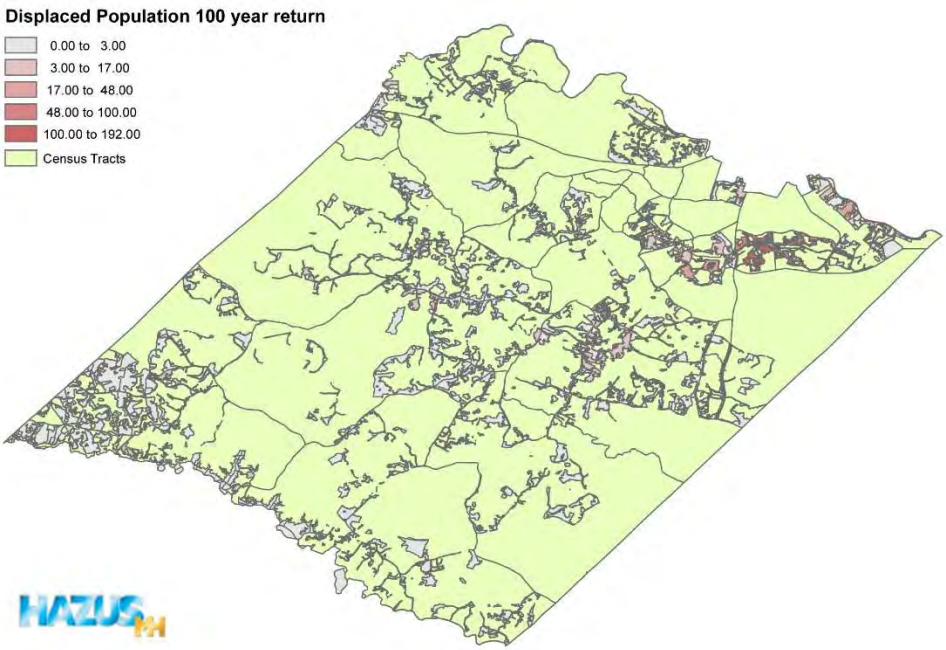
Source: Spotsylvania County, Virginia Dept. of Forestry.



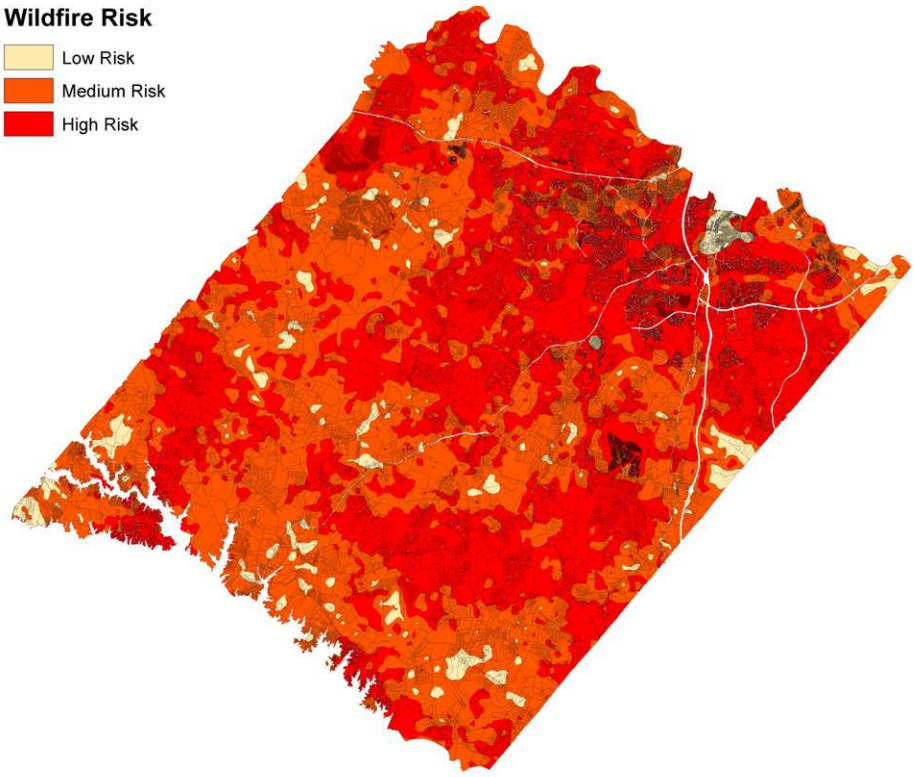
Residential Loss; 100-year Non-Rotational Wind Event; Spotsylvania County. HAZUS.



Residential Loss; 100-year Flood Event; Spotsylvania County. HAZUS.



Displaced Population; 100-year Flood Event; Spotsylvania County. HAZUS.



Wildfire Risk; Spotsylvania County. VDOF.

5.2.5 - Stafford County Vulnerability Assessment

Development Trends

Stafford County's population increased from 92,446 in the 2000 census to 128,961 in 2010 census, a 39.5% increase. This growth far exceeded the 13% overall population growth of the State of Virginia for this period. The estimated population of Stafford County for the year 2015 was 142,003. Population projections maintained by the Virginia Employment Commission call for County population to reach 178,152 by 2020 and climb further to 244,410 by 2030.

As of 2016, there are 43,038 jobs in Stafford, led by local and federal government employers, but with strong healthcare, professional services, and retail sectors. Unemployment in the County stands at 4.1 % as of October 2016, matching the overall unemployment rate for the State of Virginia, and beating the national average of 4.7%. While many residents of Stafford are employed, a large number commute to locations outside of the County for work, primarily to jobs within the Washington D.C. metropolitan area.

Stafford County's close proximity to Washington, D.C. has allowed its economic base to capitalize on government-related industry and high-tech jobs. Major employers include GEICO Insurance (regional headquarters, 3900 employees), McLane Mid-Atlantic (retail distribution, 850 employees), and Intuit, Inc. (computer services, 600 employees). Northrop Grumman (information technology/engineering) and BAE Systems (weapon systems) employ an additional 585 high-tech professionals. The U.S. Marine Base Quantico occupies 32,753 acres of Stafford County and employs 6,959 civilians ($48 million civilian payroll). The FBI relocated its National Lab to Stafford in 2003 and employs 900 persons, with an additional 900 employees at the FBI Academy and the local FBI office.

New jobs in Stafford County rose 5.6% annually between 1999 and 2004. The number of businesses in Stafford County grew 34% from 1999 to 2004. As of July 8, 2005, Stafford County had 104 active commercial developments claiming an approximate 2.5 million square feet of office space.

As the County continues to development, areas for future growth should be weighed against areas vulnerable to natural hazards to determine ideal or priority growth areas. Hazard mitigation through land use planning can reduce the cost of future natural hazard events, both in risk to human life and in damage to public and private property.

Critical Facilities

In order to assess the vulnerability of a community to natural hazards, this plan provides an inventory of critical structures and facilities in Stafford County. The critical facilities are the community's assets that are the most important or vital to emergency management. Critical facilities include:

- Emergency Operation Center (EOC);
- Emergency Communications Center (ECC) / 911;
- Law Enforcement Offices;
- Fire / Rescue Stations;
- Emergency Medical Services (EMS);
- Power;
- Communications;
- Water;

- Wastewater Treatment Plants (WWTP);
- Shelters; and
- Administration Buildings / Courthouse.

Critical facilities should be given special attention in preparing for a disaster because of their vital importance to maintaining citizen life, health, and safety during and directly after a disaster event.

Critical Facilities – Stafford County

Facility Name	City	Facility Type
Stafford Sheriff's Office	Stafford	Sheriff/EOC
Aquia Harbor Police	Stafford	Police Dept
Dept. of Fire, Rescue, and Safety	Stafford	Fire/Rescue
Stafford County Fire Marshall	Stafford	Fire Marshall
Stafford Volunteer Fire Assn	Stafford	Fire Dept Headquarters
Company 8 Rock Hill Volunteer Fire	Ruby	Fire
Company 1 Falmouth	Falmouth	Fire D
Company 3 Widewater Fire and Rescue	Stafford	Fire / Rescue
Company 4 Mountain View Fire	Stafford	Fire
Rescue 4 Mountain View EMS	Falmouth	EMS
Company 6 Hartwood Volunteer Fire & Rescue	Hartwood	Fire/Rescue
Rescue 7 White Oak EMS	Falmouth	Fire
Company 12 Berea Fire & Rescue	Stafford	Fire / Rescue
Company 9 Aquia Fire & Rescue	Stafford	Fire/Rescue
Company 7 White Oak Fire	Falmouth	Rescue
Rescue 8 Rock Hill EMS	Ruby	EMS
Company 2 / Rescue 1 Stafford Fire & Rescue	Stafford	Fire/EMS
Company 5 Brooke Fire & Rescue	Brooke	Fire/EMS
Company 14 North Stafford Fire	Stafford	Fire
Company 10 Potomac Hills Fire & Rescue	Stafford	Fire/Rescue
Smith Lake Water Treatment Facility	Stafford	Potable Water
Abel Lake WTP	Stafford	Potable Water
Aquia Wastewater Treatment Facility	AQUIA	Wastewater
Little Falls Run Wastewater Treatment Facility	Stafford	Wastewater Treatment
Stafford County Schools Administration Center	Stafford	Administration
Anne E. Moncure Elementary	Stafford	School/Shelter Site
Garrisonville Elementary	Stafford	School/Shelter Site
Park Ridge Elementary	Stafford	School/Shelter Site
Ferry Farm Elementary	Stafford	School/Shelter Site
Widewater Elementary	Stafford	School/Shelter Site
Falmouth Elementary School	Stafford	School/Shelter
Conway Elementary	Fredericksburg	School/Shelter Site
Hampton Oaks Elementary	Stafford	School/Shelter Site
Stafford Elementary	Stafford	School/Shelter Site
Kate Walker Barrett Elementary	Stafford	School/Shelter Site
Margaret Brent Elementary	Stafford	School/Shelter Site

Facility Name	City	Facility Type
Rockhill Elementary	Stafford	School/Shelter Site
Grafton Village Elementary	Fredericksburg	School/Shelter Site
Winding Creek Elementary	Stafford	School/Shelter Site
Rocky Run Elementary	Fredericksburg	School/Shelter Site
Anthony Burns Elementary	Stafford	School/Shelter Site
Hartwood Elementary	Stafford	School/Shelter Site
T. Benton Gayle Middle	Fredericksburg	School/Shelter Site
Stafford Middle	Stafford	School/Shelter Site
Shirley C. Heim Middle	Stafford	School/Shelter Site
Rodney E. Thompson Middle	Stafford	School/Shelter Site
H. H. Poole Middle	Stafford	School/Shelter Site
Edward Drew Middle	Falmouth	School/Shelter Site
Dixon-Smith Middle	Fredericksburg	School/Shelter Site
A.G. Wright Middle	Stafford	School/Shelter Site
North Stafford HIgh	Stafford	School/Shelter Site
Mountain View High	Stafford	School/Shelter Site
Stafford High	Stafford	School/Shelter Site
Brooke Point High	Stafford	School/Shelter Site
Colonial Forge High	Stafford	School/Shelter Site

Source: Data provided by the Stafford County Fire and Rescue Department.

Non-Rotational Wind Vulnerability

The HAZUS analysis tool was used to assess the vulnerability of the locality to hurricane wind hazards. Options provided by HAZUS for this analysis are the probabilistic and deterministic methods. The probabilistic scenario is the default option and relies on a database of many thousands of storm tracks and intensities. This scenario generates hurricane hazards based on set return periods. These return periods define the statistical probability that a storm of a given size and intensity could occur within any year.

The probabilistic wind analysis was chosen because it provides the statistical probability for a range of hurricane events and presents a comparison of these events. The probabilistic analysis was used to generate structural loss estimations for hurricane events with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, 500-, and 1000-year. The recurrence interval is the average interval of time within which the given hurricane event will be equaled or exceeded once.

Because residential structures comprise a significantly large percentage of the occupancy classification within all subject localities, these data are presented in below.

Hurricane Risk – Stafford County. Summary of Probability Analysis – Residential Structures

Return Period	Residential Building Damage			
	Minor Damage	Moderate Damage	Severe Damage	Total Destruction
10-year	0	0	0	0
20-year	0	0	0	0
50-year	6	0	0	0
100-year	19	0	0	0
200-year	122	2	0	0
500-year	725	29	0	0
1000-year	1,696	88	0	0

Source: HAZUS, 2016

Hurricane Risk – Stafford County. Summary of Probability Analysis – Economic Loss

Return Period	Property Damage – Capital Loss		Business Interruption
	Residential ($)	Total ($)	Income Loss ($)
10-year	0	0	0
20-year	0	0	0
50-year	733,000	733,000	0
100-year	7,226,000	7,383,000	0
200-year	20,064,000	20,235,000	8,000
500-year	53,098,000	53,567,000	1,100,000
1000-year	82,819,000	83,825,000	2,837,000

Source: HAZUS, 2016

Flooding Vulnerability

Repetitive Loss Properties

Stafford County includes 601 properties enrolled in the National Flood Insurance Program (NFIP), of which 11 are classified as Repetitive Loss properties. All 11 of these classified Repetitive Loss properties are residential properties. A Repetitive Loss property is defined as any insurable building for which two or more claims of more than $1,000 were paid by the NFIP over any rolling 10-year period since 1978. A Severe Repetitive Loss property is defined as any insurable building for which four or more claims of more than $1,000 were paid by the NFIP over any rolling 10-year period since 1978. Repetitive Loss properties strain the resources of the NFIP, while remaining at risk for future property damage, injury, or loss of life. In these cases, the primary objective of the NFIP, and of this plan, is to promote permanent solutions to repetitive flooding problems, either through structural measures that reduce or eliminate the flooding risk, or by removal of structures within high risk flood areas.

HAZUS Flood Analysis

The HAZUS analysis tool was used to assess the structural and economic impact of predicted flood events on the locality. Hazard type options provided by HAZUS for flood analysis are the riverine, coastal, and combined riverine and coastal scenarios. The necessary scenario for any given situation depends upon the geography of the region. If the area is inland with a stream hydrology, then the riverine scenario should be used. If however, the area is along the coast then either the riverine and coastal, or coastal scenario should be used.

The riverine analysis was chosen for Stafford County. This scenario provides the statistical probability for a range of flood events and presents a comparison of those events. The riverine analysis was used to generate structural loss estimations, agricultural loss estimations, and shelter requirements for flood events with specific recurrence intervals; 10-, 20-, 50-, 100-, 200-, and 500-year. The recurrence interval is the average interval of time within which the given flood event will be equaled or exceeded once. The data included below represents the likely effects on the 100-year flood event on the community.

Flood Risk – Stafford County

Occupancy Type	Dollar Exposure (replacement value $)	Percent of total
Residential	$2,971,309,000	84.5%
Commercial	$323,293,000	9.2%
Industrial	$69,330,000	2.0%
Agricultural	$10,629,000	0.3%
Religion	$70,238,000	2.0%
Government	$17,374,000	0.5%
Education	$55,968,000	1.6%
TOTAL	**$3,518,141,000**	**100%**

Source: HAZUS, 2016

In addition to the above cited economic impacts to local structures, HAZUS estimates the displacement of 394 households as the result of a hypothetical 100-year flood event, with 665 people seeking emergency shelter within the community.

Wildfire Vulnerability

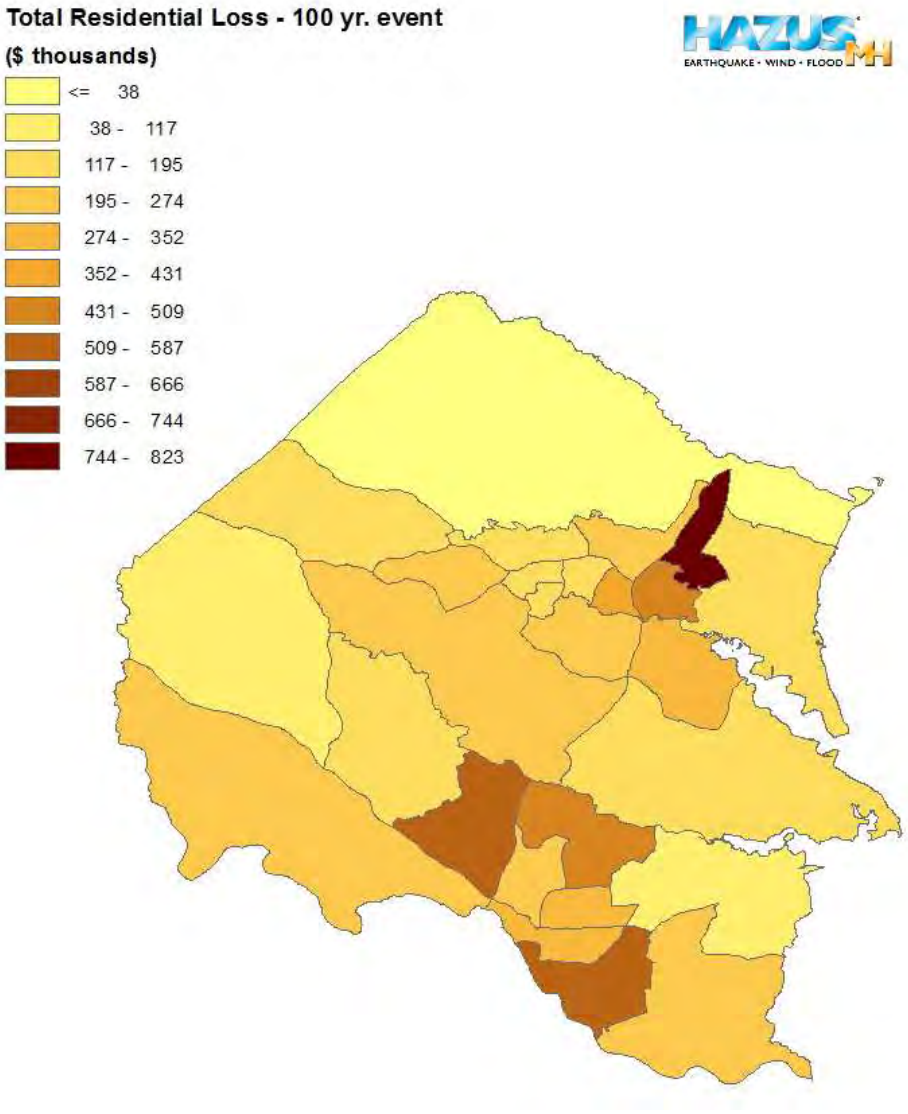
The Virginia Department of Forestry tracks wildfire events, including their location, size, frequency, and damages caused. Using this data, among other resources, VDOF classifies areas of the state based on their relative fire risk. This plan intersects wildfire area classifications generated by the VDOF with local parcel mapping and tax assessment data to determine the number of parcels located within high wildfire risk zones, and to quantify the value of real estate improvements (mainly buildings) that would be at risk in the event of a wildfire. individual counties and city that is encompassed by the GW Region provided

hardcopy tax parcel information. Of particular importance to this analysis are the number of critical community facilities located within high wildfire risk areas. Government buildings, emergency facilities, schools, and other critical locations must be able to continue their function in the event of natural disasters. These facilities are best located in the least vulnerable areas of the locality, or should have contingency plans in place should they themselves be affected by natural hazards.

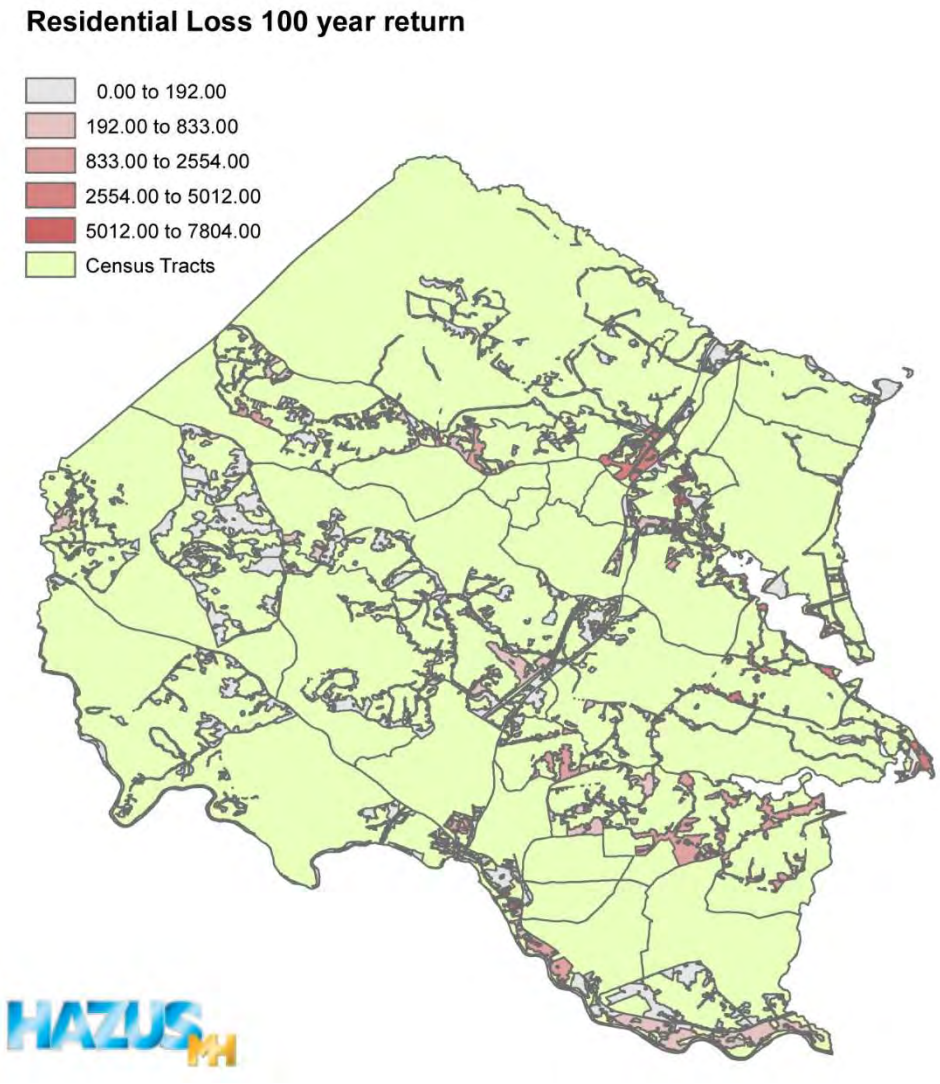
Wildfire Risk—Stafford County

Total No. Parcels	No. Parcels in High Wildfire Zone	Estimated at Risk Value
56,871	38,331	$8,469,310,400

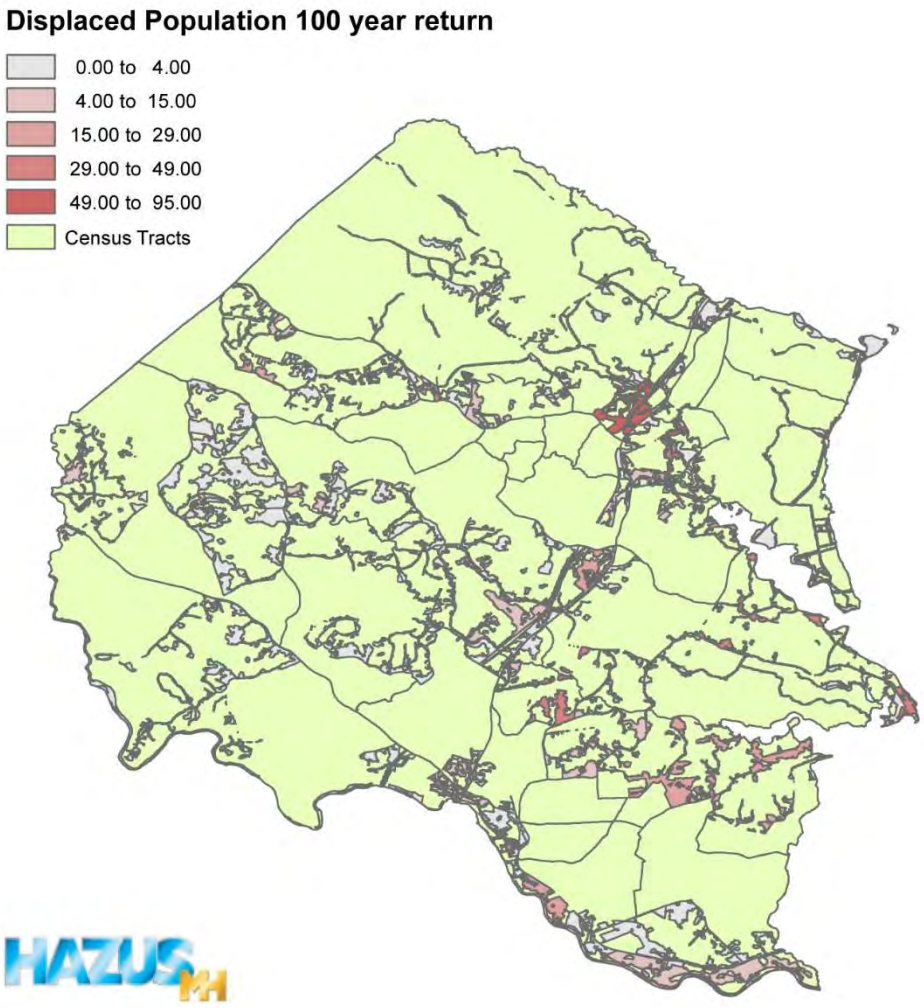
Source: Stafford County, Virginia Dept. of Forestry.



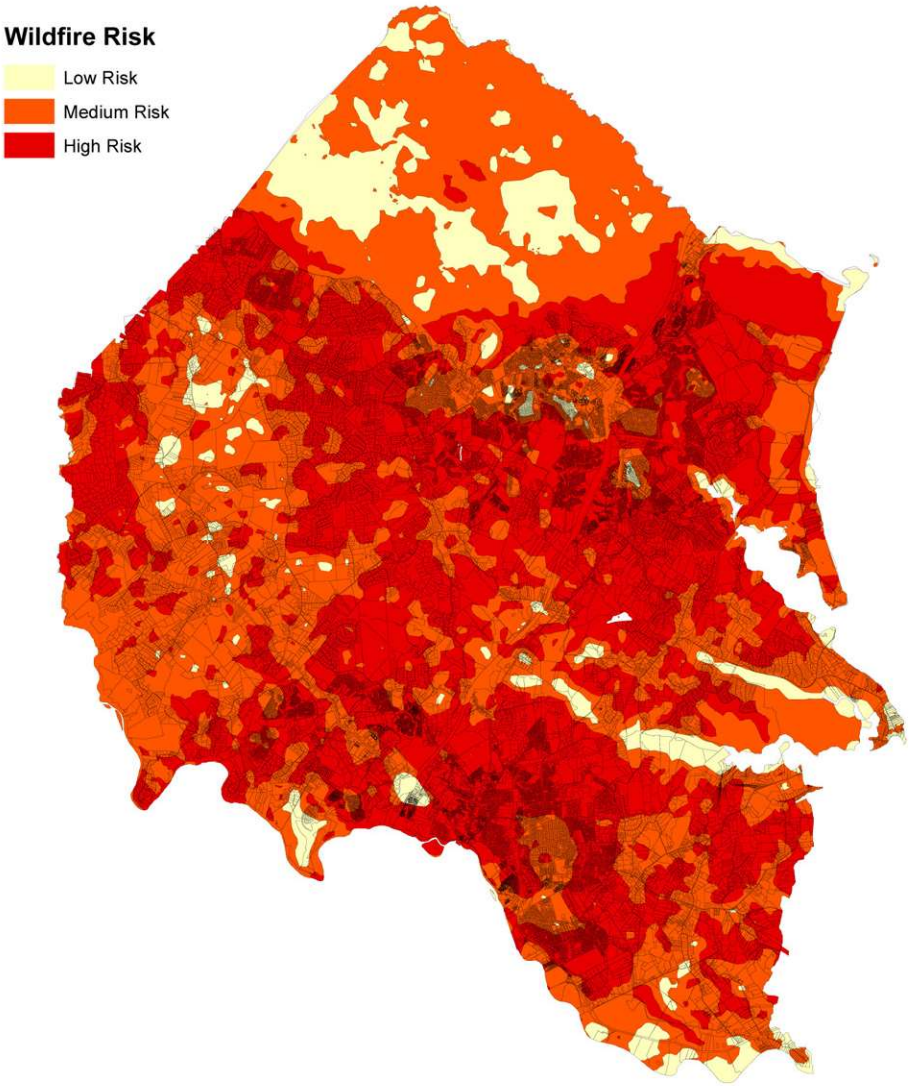
Residential Loss; 100-year Non-Rotational Wind Event; Stafford County. HAZUS.



Residential Loss; 100-year Flood Event; Stafford County. HAZUS.



Displaced Population; 100-year Flood Event; Stafford County. HAZUS.



Wildfire Risk; Stafford County. VDOF.

GEORGE WASHINGTON
REGIONAL COMMISSION

6:
Capability Assessment

6 - CAPABILITY ASSESSMENT

The capability assessment provides each member jurisdiction with a better understanding of its own preparedness levels and its capability to mitigate against natural hazards. This assessment will assist the GWRC communities to focus the goals, objectives, and proposed actions of this plan more accurately. The capability assessment contains information on existing policies, regulations, and plans.

6.1 - Regional Capability Assessment

Federal, State and Regional mitigation capabilities that are common to all communities within the GWRC planning area are presented below. The mitigation capabilities of each community are individually identified and presented in Sections 6.2.1 through 6.2.5 below.

6.1.1 - Federal Capabilities

Federal Emergency Management Agency (FEMA): The Stafford Act

This Act constitutes the statutory authority for most Federal disaster response activities especially as they pertain to FEMA and FEMA programs. Federal assistance for the repair of public roads damaged by a natural disaster not covered by the FHWA's ER program is available through the disaster relief program administered by the Federal Emergency Management Agency under the Stafford Act.

The National Flood Insurance Program (NFIP)

Established in 1968, the NFIP provides flood insurance in nearly 20,000 communities across the United States and its territories that agree to regulate new development in identified Special Flood Hazard Areas through the adoption and enforcement of a minimum Flood Damage Prevention Ordinance. The program also requires, as a condition of every federally-backed mortgage within an identified Special Flood Hazard Area, the purchase and maintenance of a flood insurance policy for the life of the loan. Community participation in the NFIP is voluntary. Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Flood damage is reduced by nearly $1 billion a year through communities implementing sound floodplain management requirements and property owners purchasing of flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately eighty percent (80%) less damage annually than those not built in compliance.

In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the Nation's floodplains. Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance.

Federal Highway Administration (FHWA): Emergency Transportation Operations (ETO)

FHWA, through the ETO programs, provides tools, guidance, capacity building and good practices that aid local and State DOTs and their partners in their efforts to improve transportation network efficiency and public/responder safety when a non-recurring event either interrupts or overwhelms transportation operations. Non-recurring events may range from traffic incidents to traffic Planning for Special Event (PSE) to disaster or emergency transportation operations (Disaster ETO). Work in ETO program areas focuses on using highway operational tools to enhance mobility and motorist and responder safety. Partnerships in ETO program areas involve non-traditional transportation stakeholders since ETO programs involve transportation, public safety (fire, rescue, emergency medical service [EMS]), law enforcement) and emergency management communities. ETO, as a discipline, spans a full range of activities: from transportation-centric (fender benders) to those where transportation is a critical response component (e.g., hurricane evacuations).

Federal Highway Administration (FHWA): Federal-aid Highway Emergency Relief Program

The Emergency Relief (ER) program - administered by the Federal Highway Administration (FHWA) - is intended to supplement the commitment of resources by States, counties, and cities (or other Federal agencies when appropriate) to help pay for unusually heavy expenses resulting from extraordinary conditions. The Congress has authorized ER funding as part of the FHWA's Federal-aid highway program. ER funds are available for the repair of Federal-aid highways or roads on Federal lands that have been seriously damaged by natural disasters over a wide area or by catastrophic failures from an external cause. Examples of natural disasters include floods, hurricanes, earthquakes, tornadoes, tidal waves, severe storms, or landslides. A bridge suddenly collapsing after being struck by a barge is an example of a catastrophic failure.

State highway agencies, working with local officials, have established the functional classification of all public roads, ranging from high service level arterials to lower service local streets. Federal-aid highways are all the public roads not functionally classified as either local or rural minor collectors. As a result, Federal-aid highways include the more important State, county, and city roads. Based on the functional classifications, about one-quarter of the overall public road mileage has been designated as Federal-aid highways. The FHWA's ER program is limited to the repair of Federal-aid highways (as previously defined) or roads on Federal lands. See the Federal Emergency Management Agency's disaster relief program under the Stafford Act for the repair of public roads not covered by the FHWA's ER program.

U.S. Department of Energy (DOE): Disaster Recovery and Building Reconstruction Program

The U.S. Department of Energy (DOE) is working to encourage cost-effective, durable, and energy-efficient building reconstruction in areas struck by natural disasters. The Building Technologies Program offers information and resources for state and local officials, builders, and consumers, as well as training opportunities on building technologies and designs that can make a long-term difference in areas vulnerable to natural disasters. When applied, these technologies can result in safer, healthier, more economically viable communities that are less susceptible to disaster.

U.S. Fish and Wildlife Service (USFWS): The Coastal Barrier Resources Act (COBRA)

Established in 1972, the COBRA is environmental legislation administered by the U.S. Fish and Wildlife Service. The legislation provides for the identification and protection of Coastal Barrier Resources. The Act further prohibits the availability of federally-backed assistance within identified areas, including grants, loans, mortgages, and federal flood insurance.

National Oceanic and Atmospheric Administration (NOAA): Coastal Zone Management Act (CZMA)

Established in 1972, and amended by the Coastal Zone Protection Act of 1996, the CZMA defines a national interest in the effective management, beneficial use, protection, and development of the coastal zone and identifies the urgent need to protect the natural system from these competing interests.

The Virginia Department of Environmental Quality (DEQ) oversees the Virginia Coastal Resources Management Program, which was established to protect and manage an area known as Virginia's "coastal zone." All seven of the GWRC communities are located in the coastal zone as defined by Virginia's Coastal Resources Management Area. The program has produced a large number of publications and assisted in the development of numerous projects to support their ten primary goals, available online.

In November 2011, GWRC adopted a regional green infrastructure plan developed under a multi-year CZM-funded grant. This plan identifies core areas where high value natural habitats and forested areas are recommended for conservation emphasis, promotes low-impact development and conservation practices to support and encourage voluntary land conservation, water quality pollution reduction and successful Chesapeake Bay watershed total maximum daily load (TMDL) implementation efforts in the Region. Such programs (along with local compliance with and implementation of the State stormwater management regulations) are expected to have an impact on reducing the risk of flooding by increasing the absorption, retention, and infiltration of stormwater that feeds rivers and streams in heavy rainfall events.

Environmental Protection Agency's Chesapeake Bay TMDLs

In 1998, major portions of Chesapeake Bay and its tidal tributaries within Virginia were identified as not meeting water quality standards and listed as impaired. Areas of the Bay and tidal rivers within Maryland, Delaware and the District of Columbia are also on the federally approved list of impaired waters. The main pollutants causing these impairments are nitrogen, phosphorus, and sediment. Significant efforts have been taken and resources expended by federal, state, and local governments and other interested parties throughout the entire 64,000 square mile Chesapeake Bay watershed. Despite these efforts, the water quality goals under the Clean Water Act have yet to be met.

Because these Bay waters remained impaired in 2008, the six Chesapeake Bay Watershed States (Virginia, Maryland, Delaware, West Virginia, Pennsylvania, and New York), the District of Columbia, and U.S. Environmental Protection Agency agreed that a Total Maximum Daily Load (TMDL) needed to be developed. EPA has assumed primary responsibility for the establishment of the Bay TMDL with assistance from the Bay watershed states.

The Chesapeake Bay TMDL will address all segments of the Bay and its tidal tributaries that are impaired. As with all TMDLs, a maximum aggregate watershed pollutant loading necessary to achieve the Chesapeake Bay's water quality standards will be identified. This aggregate watershed loading will be divided among the Bay states and major tributary basins, as well as by major source categories [wastewater, urban storm water, agriculture, air deposition]. Each community in the watershed will be required to develop a watershed implementation plan (WIP), demonstrating how the locality will achieve the target pollution reduction goals assigned to them.

6.1.2 - State Capabilities

Virginia Department of Emergency Management (VDEM)

Commonwealth of Virginia Emergency Operations Plan

Virginia's Emergency Operation Plan was last adopted in 2012, and updated in March 2015. The Plan provides the framework for how the state will support impacted local governments, individuals, and businesses in the event of disasters, and outlines how Virginia will work with the federal government to deliver federal disaster assistance. The plan consists of a Basic Plan as well as sub-plans covering Emergency Support Functions, other Support Functions, and seven hazard-specific volumes.

Virginia Emergency Alert Systems (EAS) Stations

Virginia is divided into 14 LOCAL AREAS (formerly "operational areas") which coordinate EAS activities under the direction of the Local Emergency Communications Committee (L.E.C.C.). The LECC Chair and Vice-Chair are appointed by the FCC and the State Chair; they are also members of the State Emergency Communications Committee (S.E.C.C.). The George Washington Region is divided into Area 2 "Fredericksburg Local Area" (including City of Fredericksburg, and Stafford, Spotsylvania, King George, and Fauquier Counties) and part of the "Richmond Extended Local Area" (including Caroline County).

Specific AM/FM radio stations provide updated disaster and directional information to listeners in the Commonwealth. Thirty-seven radio stations cover fourteen regions in Virginia, including: Northern Va.-D.C. (2 AM stations, 2 FM stations), Richmond extended area (2 AM stations, 2 FM stations), and Fredericksburg [1 AM station (WRVA-AM), 2 FM stations (WFLS-FM, WBQB-FM), North Anna Early Warning Siren System], which provide coverage for the GWRC planning area.

Statewide Communication Interoperability Plan

Interoperability is the ability of public safety agencies to talk across disciplines and jurisdictions via radio communications systems, exchanging voice and/or data with one another on demand in real time, when needed, and as authorized. The lack of interoperable communications is not a new public safety problem, but new events continue to remind us of the pressing problem it poses to public safety departments and emergency response agencies. Major disaster events have demonstrated the need for improved communications systems and collaboration and planning among various jurisdictions.

The Virginia SCIP has served as the backbone for regional and local interoperable communications planning. It establishes a future vision for communications interoperability and aligns the Commonwealth's emergency response agencies with that vision and the goals, objectives, and initiatives for achieving that vision. The first Virginia statewide plan was released in 2005 and it defined statewide initiatives designed to improve interoperable communications. The current version of the plan was adopted in 2013.

The GWRC Region is divided between two sub-state Regional Preparedness Advisory Committee (RPAC) regions: Region 1 (with Caroline and King George Counties) and Region 2 (with Spotsylvania and Stafford Counties and the City of Fredericksburg). The GWRC Board of Directors has asked GWRC staff to work with local public safety agencies to encourage collaboration and cooperation, leading to potential cost-sharing or other economy-of-scale benefits arising from regional cooperation.

Virginia Department of Conservation and Recreation (VDCR)

Virginia Stormwater Management Act and Regulations

The Virginia stormwater act and VSMP permit regulations provide the ability to manage the quantity and quality of stormwater runoff on a construction site, as well as on a regional or watershed basis. Compared with impervious surfaces (such as pavement or rooftops), pervious surfaces (such as meadows and woodlands) absorb and filter rainfall and reduce runoff. When meadows and woodlands are developed, the increase in impervious surfaces increases the amount of runoff that occurs when it rains. This increase in runoff can overwhelm waterways, causing erosion, localized flooding and property damage.

Chesapeake Bay Regulations

As part of Virginia's commitment to help preserve and restore the resources of the Chesapeake Bay, the Virginia General Assembly adopted the Chesapeake Bay Preservation Act in 1988. The Chesapeake Bay Preservation Area Designation and Management Regulations were adopted in 1990 and amended in December 2001. The revised regulations took effect in March 2002 and localities had until December 31, 2003 to revise their local ordinances to become consistent with the new language.

The regulations require that communities east of Interstate 95, the "Tidewater" area of Virginia, regulate and enforce the use of Resource Protection Areas (RPAs) and Resource Management Areas (RMAs). The RPA is relevant to floodplain management because new development within the designated area must maintain a 100-foot buffer from the waterline of any perennial stream, as defined by the regulations. This includes all tidal water bodies in coastal areas. Both the GWRC and the VDCR provide technical assistance and guidance to communities in enforcing the regulations.

All 84 local governments subject to the Chesapeake Bay Preservation Act are required to have ordinance provisions addressing land development in Chesapeake Bay Preservation Areas that minimize impervious cover and land disturbance and preserve indigenous vegetation. DCR Chesapeake Bay Local Assistance staff members have reviewed local ordinances to identify specific provisions that address these issues and other provisions that protect water quality. To facilitate this effort, the staff is using two checklists that contain example ordinance provisions that address minimization of impervious cover, minimization of land disturbance and maintenance of indigenous vegetation. All seven local governments (including the Towns of Bowling Green and Port Royal in Caroline County) are in compliance with Chesapeake Bay Preservation Act requirements.

Virginia Flood Damage Reduction Act

Virginia's General Assembly enacted the Virginia Flood Damage Reduction Act of 1989. This legislation was the result of several disastrous floods or coastal storms that hit the state between 1969 and 1985. To improve Virginia's flood protection programs and place related programs in one agency, responsibility for coordination of all state floodplain programs was transferred in 1987 from the Water Control Board to DCR. DCR was named manager of the state's floodplain program and designated coordinating agency of the National Flood Insurance Program under the act, §10.1-602, and a governor's memorandum released in July 1997.

Floodplain Management Program staff works with localities to establish and enforce floodplain management zoning. Localities use the program's state model ordinances, in which minimum standards for local regulations are set, to write their own. Local governments can set more restrictive standards to

ensure higher levels of protection for residents in flood hazard areas. Also, the state has used the Virginia Uniform Statewide Building Code to set construction standards for structures built in Federal Emergency Management Agency designated flood hazard areas.

Floodplain zoning regulates how development is allowed within floodplains. The program's main goal is to protect people and their property from unwise floodplain development. It also protects society from costs associated with developed floodplains.

Virginia Dam Safety Act

The Virginia Soil and Water Conservation Board established the state's dam safety regulations as a result of the passage of the Virginia Dam Safety Act. The Dam Safety Program's purpose is to provide for safe design, construction, operation and maintenance of dams to protect public safety. The program enforces permit requirements related to the construction and alteration of impounding structures. All dams in Virginia are subject to the Dam Safety Act unless specifically excluded. Inundation mapping is required for all Class I and Class II dams in the Commonwealth. Dam Safety Program officials recommend mapping for all classified dams (VS&WCB, 2005).

The Virginia Dam Safety Act, Article 2, Chapter 6, Title 10.1 (10.1-604 et seq) of the Code of Virginia and Dam Safety Impounding Structure Regulations (Dam Safety Regulations), established and published by the Virginia Soil and Water Conservation Board (VSWCB). New regulations were put into effect Sept. 26, 2008, which regulations require dam break inundation zone mapping in order to identify areas that will be subject to flooding during a dam failure.

Shoreline Erosion Advisory Service (SEAS)

VDCR's Shoreline Erosion Advisory Service promotes environmentally acceptable shoreline and riverbank erosion control measures to protect private property and reduce sediment and nutrient loads to the Chesapeake Bay and other waters of the Commonwealth. In addition, the program promotes research for improved shoreline management techniques to protect and enhance Virginia's shoreline resources.

Since SEAS was created in 1980, VDCR has provided technical advice about tidal shoreline erosion problems to more than 7,000 clients. They include landowners, local governments and environmental agencies. SEAS program activities also help local governments deal with sediment and nutrient loads from shoreline erosion and, of course, address the Commonwealth's obligation to reduce sediment and nutrient loads in the Chesapeake Bay and its tributaries.

Virginia Department of Forestry (VDOF)

The Virginia Department of Forestry (VDOF) is responsible for the protection of 15.8 million acres of forest land from fire, insects and disease. The principle goals of the Forest Protection Program are to prevent injury or loss of human life, minimize property damage and protect resources.

VDOF has a well-defined and organized forest protection team, with every member of the Department having fire responsibilities. The ability to adapt to emergencies enables a small formal fire suppression force to limit annual fire losses to an average of less than 8,200 acres (10-year average). This low average is accomplished through coordination with local fire departments, forest industry, federal agencies, other state agencies and VDOF organized volunteer fire crews.

Virginia Marine Resources Commission (VMRC)

The Virginia Marine Resources Commission was established in 1875 as the Virginia Fish Commission. The Virginia Wetlands Act was passed in 1972 and placed under the management of VMRC, as was the 1980 Coastal Primary Sand Dune Protection Act. In 1982, the General Assembly broadened the 1972 Wetlands Act to include non-vegetated wetlands. The Habitat Management Division issues three types of Environmental Permits: subaqueous or bottomlands, tidal wetlands, and coastal primary sand dunes. The division's authority specifically regulates physical encroachment into these valuable resource areas.

The permit process relies on a single Virginia joint local/state/Federal permit application. The review process takes into account various local, state and Federal statutes governing the disturbance or alteration of environmental resources. The Marine Resources Commission plays a central role as an information clearinghouse for all three levels of review. Applications receive independent yet concurrent review by the community's Wetlands Board, the VMRC, the Virginia Department of Environmental Quality, and the U.S. Army Corps of Engineers.

Department of Housing and Community Development

The Commonwealth of Virginia is responsible for enacting the Virginia Uniform Statewide Building Code (VUSBC), and each county or city is responsible for enforcing the code locally. The code contains the building regulations that must be complied with when constructing a new building or structure or an addition to an existing building, maintaining or repairing an existing building, or renovating or changing the use of a building or structure.

Enforcement of the VUSBC is the responsibility of the local government's building inspections department. The VUSBC contains enforcement procedures that must be used by the enforcing agency.

As provided in the Uniform Statewide Building Code Law, Chapter 6 (36-97 et seq.) of Title 36 of the Code of Virginia, the USBC supersedes the building codes and regulations of the counties, municipalities and other political subdivisions and state agencies related to any construction, reconstruction, alterations, conversion, repair or use of buildings and installation of equipment therein. The USBC does not supersede zoning ordinances or other land use controls that do not affect the manner of construction or materials to be used in the construction, alteration, or repair.

6.1.3 - Regional Capabilities

George Washington Regional Commission (GWRC)

One of 21 Planning District Commissions in the Commonwealth of Virginia, GWRC is a political subdivision representing seven local governments. Planning District Commissions are voluntary associations created pursuant to the Virginia Area Development Act adopted in 1969. The purpose of planning district commissions, as set out in the Code of Virginia, Section 15.2-4207 is "…to encourage and facilitate local government cooperation and state-local cooperation in addressing on a regional basis problems of greater than local significance." GWRC serves as a resource of technical expertise to its member local governments. Specific programs affiliated with GWRC include coastal zone environmental planning, regional all-hazards mitigation planning, transportation, ridesharing, telecommuting, and environmental concerns, which are described below.

Fredericksburg Area Metropolitan Planning Organization (FAMPO)

Based upon the 1990 Census, the Fredericksburg, VA area was designated an urbanized area (population greater than 50,000). To continue receiving federal funds for transportation improvements, federal law requires all urbanized areas in the United States to conduct the "3-C" (continuing, comprehensive and cooperative) transportation planning process. In response to the Census designation, a "Memorandum of Understanding" was signed in November 1992 between the Commonwealth of Virginia (and its participating agencies), the three jurisdictions (City of Fredericksburg, & Counties of Spotsylvania and Stafford), and the Potomac and Rappahannock Transportation Commission (PRTC) to create the Fredericksburg Area Metropolitan Planning Organization (FAMPO) FAMPO's policy board is the federally-recognized transportation policy board for the "urbanized" portion of Planning District 16, which includes the City of Fredericksburg and Spotsylvania and Stafford counties. FAMPO is responsible for developing a Constrained Long Range Plan (CLRP), managing the regional Transportation Improvement Program (TIP) and developing an annual Unified Planning Work Program (UPWP). In addition, FAMPO also prepares critical regional transportation planning studies. Transportation planning activities in Caroline and King George Counties through the VDOT's Rural Transportation Planning Assistance Program is coordinated with FAMPO's urban transportation planning program. Staffing for FAMPO is provided by the George Washington Regional Commission.

GWRideConnect

GWRideConnect is the ridesharing agency that serves the Region, and promotes ridesharing and transportation demand management (TDM) techniques to assist persons seeking transportation options to their workplaces and other destinations. The program promotes, plans, and establishes transportation alternatives to improve air quality, reduce congestion, and improve the overall quality of life for the citizens in the region.

The GWRideConnect program assists in the creation of new commuter pools (cars, vans, and buses) and works toward keeping these pools successfully operating. The program also acts as an information clearinghouse for persons interested in the benefits, services and options of mass transportation. GWRideConnect distributes match letters and packets containing information on van, car and bus pools, as well as information on the Virginia Railway Express (VRE), Washington Metro System and telecommuting.

Fredericksburg Regional Alliance (FRA)

FRA is a public, private economic development marketing partnership created to provide CEOs, presidents, corporate real estate executives, facility planners, and site selection consultants with a single source for comprehensive demographic and economic information on the Fredericksburg Region -- which includes the City of Fredericksburg and the counties of Caroline, King George, Spotsylvania, and Stafford -- while also providing a wide range of services designed to facilitate the site selection process.

By working in cooperation with local economic development offices, the Virginia Employment Commission (VEC), educational institutions, and other regional groups, the Alliance is able to offer a truly comprehensive collection of services and information, including: demographic and economic data; community tours; site, building, and office space inspections; industry-specific wage, workforce, and labor availability information; tax and cost of living comparisons; financing options; and confidential project-specific proposals from localities.

The Rappahannock River Basin Commission (RRBC)

The RRBC's mission and purpose as stated in Section 62.1-69.27 of the Code of Virginia is: "(T)o provide guidance for the stewardship and enhancement of the water quality and natural resources of the Rappahannock River Basin. The Commission shall be a forum in which local governments and citizens can discuss issues affecting the Basin's water quality and quantity and other natural resources." The RRBC's Water Allocation Group was created in the spring of 2000 to facilitate and encourage the planning for water allocation, including water supply and discharge in the Rappahannock. Participants included local and state elected officials, representatives of utilities departments in the basin, local, state and federal environmental agencies and others. The Water Allocation Group was chaired by the Chair of the Rappahannock River Basin Commission. The Water Allocation Group developed many recommendations for the Commission which have in turn been adopted and forwarded to member localities and the Commonwealth of Virginia. A major project of the Water Allocation Group was the development of the Water Supply Planning Model.

To assist in water resource and water-quality planning, the Rappahannock River Basin Commission has published several documents for the local communities. These documents are Guiding Principles for Water Resource Planning, Planning for Groundwater use in the Rappahannock Basin, and Groundwater Planning: Recommendations by the Water Allocation Group to the Rappahannock River Basin Commission.

Climate, Environment, and Readiness Plan (CLEAR Plan)

In 2012, the University of Mary Washington began a partnership with businesses, nonprofits, public agencies, and interested residents throughout the Region to develop the CLEAR Plan. This plan is focused on awareness of the importance of climate and environmental issues to the GWRC region, and on future efforts to protect from environmental dangers and disasters. This plan underscores the important relationship between the region and its various institutions and universities, and the resources that these institutions can provide to the region.

The CLEAR Plan seeks continual improvement of the region's health, economy, and institutions and infrastructure by proposing goals for future environmental planning efforts, including initiatives in the areas of economic development, emergency preparedness, waste, soil and water, rivers and open spaces, and community resilience.

6.2 - Community Specific Capability Assessment

To evaluate the ability of GWRC member communities' ability to plan, develop, and implement hazard mitigation activities, the following section presents local capability assessments for each jurisdiction. This assessment is designed to highlight both the regulatory tools available to the community to assist with natural hazard mitigation and the other community assets that may help facilitate the planning and implementation of natural hazard mitigation over time. This information outlines the current and planned programming that will impact the ability of these areas to plan for and mitigate against natural hazards.

6.2.1 - Caroline County Capability Assessment (incl. Towns of Bowling Green and Port Royal)

Form of Governance

Caroline County is governed by an elected Board of Supervisors with daily administration handled on the Board's behalf by a County Administrator and associated County staff. Caroline County contains two incorporated towns: Bowling Green and Port Royal. The Town of Bowling Green is governed by an elected Town Council and Mayor and administered on a day-to-day basis by a Town Manager. The town of Port Royal has a Council/Manager form of government, which is under the control of a professional manager.

Guiding Community Documents

Caroline County has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, suggested facility development standards, utilities plans, capital improvement plans, and emergency management plans. The County uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential planning document to the County is its Comprehensive Plan.

Comprehensive Plan, 2010

- Presents policies and strategies for growth management plan and recognizes the value in preserving the desired rural characteristics of the County
- Ensures responsible stewardship of the County's natural and historic resources, including riparian buffers, floodplains, wetlands, and historic structures and places
- Plans for continued growth and development in designated growth areas through sub-plans, including:
    - Bowling Green/Milford Plan
    - Carmel Church Plan
    - Dawn Plan
    - Ladysmith Port Royal Sub-Area Plans
- Plans for necessary transportation enhancements and improvements to service projected growth
- Plans for operation and expansion of public facilities to accommodate expected growth in the County. Facilities include water and sewer service facilities, public libraries, first response emergency services facilities (fire/EMS stations), and parks and recreation facilities.

Zoning & Development Standards

- Identifies existing federal and state regulations.
- Most of document recommends policies and standards for new and existing development.

Building Codes

The Commonwealth of Virginia is responsible for enacting the Virginia Uniform Statewide Building Code, which the County is responsible for enforcing locally. The Uniform Statewide Building Code was based on the IBC, IRC, and IFPC.

The Building Code Effectiveness Grading Schedule (BCEGS) assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards. Municipalities with well-enforced, up-to-date codes should demonstrate better loss experience, and insurance rates can reflect that. The BCEGS program assigns each municipality a BCEGS grade of 1 (exemplary commitment to building-code enforcement) to 10. The BCEGS grade for Caroline County is presented in the included table.

Flood Management

Caroline County is a participant in the National Flood Insurance Program (NFIP). The County's floodplains are mapped by Flood Insurance Rate Maps (FIRM), which are available to the public and updated with current information as needed. The County has also adopted a floodplain management ordinance meeting federal requirements, and which is regularly enforced. Further information about the County's floodplain management efforts can be found in the NFI survey included in the appendix of this document.

Public Education

Among the public outreach mechanisms available in Caroline County, the County's website provides County residents with pertinent information, provides an on-line complaint form, and answers several Frequently Asked Questions (FAQs). The County also posts most of its guiding documents, including the Comprehensive Plan, on this site.

The Town of Bowling Green also provides public outreach through its website. It, too, provides residents and visitors with timely information and guidance.

Emergency Preparedness

Caroline County utilizes a SMS and email notification system, Twitter, and the County's website to notify residents of emergency and non-emergency information. The Town of Bowling Green also utilizes a cable access channel to notify residents of information that may include emergency preparedness.

The tables below represent the identified capabilities of the Towns and Caroline County. All data was provided by a representative of that jurisdiction.

Capability Matrix - Caroline County

Capability	Caroline County
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
NFIP/FPM Ordinance	Yes
-Effective FIRM Date	15-August-89
-Substantial Damage Language	Yes
- Certified Floodplain Manager	No
- # of Floodprone Parcels	2,424
- # of NFIP policies	82
- Maintain Elevation Certificates	No
- # of Repetitive Losses	0
CRS Rating	N/A
Stormwater Program	Yes
Building Code Version	VA USBC 2012
Full-time Building Official	Yes
- Conduct “As-built” Inspections	Yes
BCEGS Rating	Residential - 3; Commercial - 3
Local Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Poor
- Storm Ready Certified	No
- Weather Radio Reception	Fair
- Outdoor Warning Sirens	No
-Emergency Notification (SMS Text)	Yes – Caroline Alert System
-other? (e.g., cable over-ride)	No
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	No
Property Owner Protection Projects	Yes-Acquisition/Elevation
Critical Facilities Protected	No
Natural Resource Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes

Capability	Caroline County
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Source: Data provided by Community.

Capability Matrix - Town of Bowling Green

Capability	Town of Bowling Green
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
NFIP/FPM Ordinance	Yes
-Effective FIRM Date	N/A
-Substantial Damage Language	N/A
- Certified Floodplain Manager	No
- # of Floodprone Buildings	N/A
- # of NFIP policies	N/A
- Maintain Elevation Certificates	No
- # of Repetitive Losses	N/A
CRS Rating	N/A
Stormwater Program	Yes
Building Code Version	VA USBC 2012
Full-time Building Official	No
- Conduct “As-built” Inspections	Yes
BCEGS Rating	Residential – 3; Commercial – 3
Local Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
- Storm Ready Certified	No
- Weather Radio Reception	Yes
- Outdoor Warning Sirens	No
-Emergency Notification (R-911)	No
-other (e.g., cable over-ride)	Yes-Cable-Emergency Alert System
GIS system	Yes
-Hazard Data	N/A
-Building footprints	N/A
-Tied to Assessor data	N/A
-Land Use designations	N/A
Structural Protection Projects	No

Capability	Town of Bowling Green
Property Owner Protection Projects	No
Critical Facilities Protected	No
Natural Resource Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	No

Source: Data provided by Community.

Capability Matrix – Town of Port Royal

Capability	Town of Port Royal
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
NFIP/FPM Ordinance	Yes
-Effective FIRM Date	2010
-Substantial Damage Language	N/A
- Certified Floodplain Manager	No
- # of Floodprone Buildings	N/A
- # of NFIP policies	N/A
- Maintain Elevation Certificates	No
- # of Repetitive Losses	N/A
CRS Rating	N/A
Stormwater Program	No
Building Code Version	VA USBC 2012
Full-time Building Official	No
- Conduct “As-built” Inspections	Yes
BCEGS Rating	Residential – 3; Commercial – 3
Local Emergency Operations Plan	No
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes – Fire House
- Storm Ready Certified	No
- Weather Radio Reception	Yes; Fire House
- Outdoor Warning Sirens	No
-Emergency Notification (R-911)	No

Capability	Town of Port Royal
-other (e.g., cable over-ride)	No
GIS system	No
-Hazard Data	N/A
-Building footprints	N/A
-Tied to Assessor data	N/A
-Land Use designations	N/A
Structural Protection Projects	No
Property Owner Protection Projects	No
Critical Facilities Protected	Fire House
Natural Resource Inventory	No
Cultural Resources Inventory	Yes
Erosion Control Procedures	Chesapeake Bay Act
Sediment Control Procedures	Chesapeake Bay Act
Public Information Program/Outlet	No
Environmental Education Program	No

Source: Data provided by Community

6.2.2 - City of Fredericksburg Capability Assessment

Form of Governance

A six-member City Council and a Mayor govern the City of Fredericksburg. The Mayor and two Council members are elected at large while the remaining four Council members are elected from the City's four wards. The City Manager and the various departments under the City Manager's authority carry out the day-to-day administration of the City's services and programming.

Guiding Community Documents

The City of Fredericksburg has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, public works, and public utilities plans, capital improvement plans, and emergency management plans. The City uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the jurisdiction guides its future is through policies laid out in the Comprehensive Plan.

Comprehensive Plan, 2015

- Presents policies and strategies for growth management
- Recognizes the value of the City's considerable natural, cultural, and historic resources.
- Recognizes the impacts of regional facilities, transportation corridors, and hospital facilities
- Ensures that development is done in an environmentally sensitive, planned manner that serves to preserve environmentally sensitive features such as floodplains, wetlands and natural topography.
- Develops a well planned, efficient, effective and safe transportation system that meets local, regional and interstate transportation needs.
- Recognizes State and federal flood and other water resource regulations, including the Chesapeake Bay Preservation Act.
- Provides land use policies for ten neighborhood planning areas of the city, and specific area plans for two of these neighborhoods.

Zoning & Development Standards

- Identifies existing federal and state regulations.
- Recommends policies and standards for new and existing development.

Building Codes

The Commonwealth of Virginia is responsible for enacting the Virginia Uniform Statewide Building Code, which the City is responsible for enforcing locally. The Uniform Statewide Building Code is based on the IBC, IRC, and IFPC.

The Building Code Effectiveness Grading Schedule (BCEGS) assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards. Municipalities with well-enforced, up-to-date codes should

demonstrate better loss experience, and insurance rates can reflect that. The BCEGS program assigns each municipality a BCEGS grade of 1 (exemplary commitment to building-code enforcement) to 10. The BCEGS grade for the City of Fredericksburg is presented in the included table.

Flood Management

The City of Fredericksburg is a participant in the National Flood Insurance Program (NFIP), and makes efforts through the City's website to educate citizens on flood insurance topics and policy changes. The City's floodplains are mapped by Flood Insurance Rate Maps (FIRM), which are available to the public and updated with current information as needed. The City has also adopted a floodplain management ordinance meeting federal requirements, and which is regularly enforced. The City has actively considered participating in the Community Rating System (CRS), but does not yet participate at this time. Further information about the City's floodplain management efforts can be found in the NFI survey included in the appendix of this document.

Public Education

Among the readily available public outreach mechanisms available in the City of Fredericksburg, the City's website provides City residents with pertinent information, including local events and information on the City's rich cultural history, and answers several Frequently Asked Questions (FAQs). The City also posts most of its guiding documents, including the Comprehensive Plan on this site.

Emergency Preparedness

The City of Fredericksburg utilizes a cable access channel, Reverse 911, Fredericksburg Alert (email and text message capability), and a Mass Notification System (Everbridge) to notify residents of information that may include emergency preparedness. The city also utilizes IFLOWS (Integrated Flood Observing and Warning Systems) river gauges, and maintains an Emergency Operation Plan.

Capability Matrix - City of Fredericksburg

Capability	City of Fredericksburg
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
NFIP/FPM Ordinance	Yes
-Effective FIRM Date	19-September- 2007
-Substantial Damage Language	Yes
- Certified Floodplain Managers	2
- # of Floodprone Buildings	300
- # of NFIP policies	178
- Maintain Elevation Certificates	Yes

- # of Repetitive Losses	4
CRS Rated	No
Stormwater Program	Yes
Building Code Version	VA USBC 2012
Full-time Building Official	Yes
- Conduct “As-built” Inspections	Yes
BCEGS Rating	Residential - 4; Commercial - 4
Local Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
- Storm Ready Certified	Yes
- Weather Radio Reception	Yes, Poor
- Outdoor Warning Sirens	No
-Emergency Notification (R-911, Fredericksburg Alert)	Yes
-other? (e.g., cable over-ride)	Yes - Emergency Alert System, Everbridge
GIS system	Yes
-Digital Hazard Data	No
-Digital Building footprints	No
-Tied to Assessor data	No
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	No
Critical Facilities Protected	No
Natural Resource Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Source: Data provided by Community.

6.2.3 - King George County Capability Assessment

Form of Governance

The County is governed by an elected five member Board of Supervisors and administered on a day-to-day basis by a County Administrator and departmental staff.

Guiding Community Documents

King George County has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, subdivision ordinance, zoning ordinance, capital improvement plans, and emergency management plans. In addition, the King George County Service Authority administers the standards and specifications governing water and sewer utility service. The County uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the jurisdiction guides its future is through policies laid out in the Comprehensive Plan.

Comprehensive Plan, 2013

The County's current Comprehensive Plan outlines the County's future planning goals, including:

- Preserve the Rural Characteristics of King George County;
- Encourage land use patterns that sustain and enhance the health, safety, morals, order, convenience, prosperity and general welfare of the residents of King George County;
- Promote a healthy, diversified economy in the County;
- Encourage protection of critical environmental resources and maintain renewable natural resources for future generations;
- Encourage a balance of residential zoning classifications to meet the needs of all county residents while concentrating and guiding growth in and around service districts as designated in this Plan;
- Seek to manage through-traffic flow on principal roads in such a manner as to minimize the impact on local-traffic flow;
- Protect water supplies and assure an adequate quality and quantity of water; and
- Encourage the construction and control of central sewage facilities in designated areas.

Zoning & Development Standards

- Identifies existing federal and state regulations.
- Provides policies and standards for new and existing development as allowed by the Code of Virginia.

Subdivision ordinance

The purpose of this ordinance is to establish standards for the subdivision of land and development procedures for King George County.

Building Codes

The Commonwealth of Virginia is responsible for enacting the Virginia Uniform Statewide Building Code, which the County is responsible for enforcing locally. The Uniform Statewide Building Code is based on the IBC, IRC, and IFPC.

The Building Code Effectiveness Grading Schedule (BCEGS) assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards. Municipalities with well-enforced, up-to-date codes should demonstrate better loss experience, and insurance rates can reflect that. The BCEGS program assigns each municipality a BCEGS grade of 1 (exemplary commitment to building-code enforcement) to 10. The BCEGS grade for King George County is presented in the included table.

Flood Management

King George County is a participant in the National Flood Insurance Program (NFIP), and makes efforts through its website and individual letter sot property owners to educate citizens on flood insurance topics and policy changes. The County's floodplains are mapped by Flood Insurance Rate Maps (FIRM), which are available to the public and updated with current information as needed. The County has also adopted a floodplain management ordinance meeting federal requirements, and which is regularly enforced. Further information about the County's floodplain management efforts can be found in the NFI survey included in the appendix of this document.

Public Education

Among the readily available public outreach mechanisms available in King George County, the County's website provides County residents with pertinent information, provides an on-line complaint form, and answers several Frequently Asked Questions (FAQs). The County posts most of its guiding documents, including the Comprehensive Plan on this site. KGALERT also serves as a source of public education through the availability and presentation of disaster and emergency preparedness information. Public information is also provided through articles published in the local weekly newspaper, The Journal, and the daily regional newspaper, The Free Lance Star. King George County Department of Fire, Rescue and Emergency Services maintains its own website, where it provides additional preparedness and disaster information.

Emergency Preparedness

The County has access to a public access cable television channel for posting emergency and other community information. Emergency notifications are provided to citizens and businesses through KGALERT, local radio station announcements, and Twitter (kgva_firerescue) postings.

Capability Matrix - King George County

Capability	King George County
Comprehensive Plan	Yes

Capability	King George County
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
NFIP/FPM Ordinance	Yes
-Effective FIRM Date	March 16, 2009; February 18, 2015
-Substantial Damage Language	Yes
- Certified Floodplain Manager	No
- # of Floodprone Buildings	300
- # of NFIP policies	79
- Maintain Elevation Certificates	Yes
- # of Repetitive Losses	0
CRS Rating	N/A
Stormwater Program	No
Building Code Version	VA USBC 2012 Edition
Full-time Building Official	Yes
- Conduct "As-built" Inspections	Yes
BCEGS Rating	Residential – 3; Commercial - 3
Local Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
- Storm Ready Certified	Yes
- Weather Radio Reception	Improved coverage due to Fredericksburg transmitter
-Emergency Notification (R-911)	Yes
-other? (e.g., cable over-ride)	KGALERT, social media
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	Yes
Property Owner Protection Projects	No
Critical Facilities Protected	Minimal
Natural Resource Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Source: Data provided by Community.

6.2.4 - Spotsylvania County Capability Assessment

Form of Governance

The County is governed by a seven member, elected Board of Supervisors and administered on a day-to-day basis by a County Administrator and subsequent departmental staff.

Guiding Community Documents

Spotsylvania County has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, public works, and public utilities plans, capital improvement plans, and emergency management plans. The County uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the jurisdiction guides its future is through policies laid out in the Comprehensive Plan.

Comprehensive Plan, 2013; updated 2016.

- Presents policies and strategies for growth management and recognizes the value in preserving the desired rural characteristics of the County.
- Strategizes to preserve the natural environment, “open space” and areas deserving special attention while providing sufficient designated growth areas to accommodate expected demand for business and residential growth.
- Ensures that development is done in an environmentally sensitive, planned manner that serves to preserve environmentally sensitive features such as floodplains, wetlands and natural topography.
- Develops a well-planned, efficient, effective and safe transportation system that meets local, regional and interstate transportation needs.
- Preserves the County's historic resources that provide valuable information about the proud history of the County and its residents.
- Improves planning information resources by completing, performing and maintaining surveys of existing resources, land uses, and facilities.
- Recognizes State and Federal flood regulations.
- Supportive of emergency services and law enforcement to protect citizens and businesses and allow them to enjoy a safe and secure environment.
- Establish levels of service standards for response times and per capita ratio of citizens served per station.

Zoning & Development Standards

- Identifies existing federal and state regulations.
- County code and Design Standards Manual contain standards for development and redevelopment. Special Overlay District regulations apply to:
    - Floodplain Overlay Districts
    - Dam Break Inundation Zones
- Statewide fire prevention code adopted resulting in Spotsylvania Open Air Burning ordinance, approved June, 2015.

Building Codes

The Virginia Uniform Statewide Building Code (USBC) is a state regulation promulgated by the Virginia Board of Housing and Community Development, a Governor-appointed board, for the purpose of establishing minimum regulations to govern the construction and maintenance of buildings and structures. The international codes are adopted by reference in the USBC. The USBC supersede the building codes and regulations of the counties. Enforcement of the provisions of the USBC for construction and rehabilitation shall be the responsibility of the local building department. The 2012 edition became effective 7-14-14.

The Building Code Effectiveness Grading Schedule (BCEGS) assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards. Municipalities with well-enforced, up-to-date codes should demonstrate better loss experience, and insurance rates can reflect that. The BCEGS program assigns each municipality a BCEGS grade of 1 (exemplary commitment to building-code enforcement) to 10. The BCEGS grade for Spotsylvania County is presented in the included table.

Flood Management

Spotsylvania County is a participant in the National Flood Insurance Program (NFIP), and makes efforts to educate its citizens on flood insurance topics and policy changes. The County's floodplains are mapped by Flood Insurance Rate Maps (FIRM), which are available to the public through the County's GIS system, and which are updated with current information as needed. The County has also adopted a floodplain management ordinance meeting federal requirements, which is regularly enforced. The County also includes a floodplain overlay district in its Zoning Ordinance. Further information about the County's floodplain management efforts can be found in the NFI survey included in the appendix of this document.

Public Education

Among the readily available public outreach mechanisms available in Spotsylvania County, the County's website provides County residents with pertinent information, provides updates on County programming and events, and answers several Frequently Asked Questions (FAQs). The County also posts most of its guiding documents, including the Comprehensive Plan, on this site. The County's cable station airs information and updates 24 hours a day and includes links to information sources.

Emergency Preparedness

Spotsylvania County utilizes a Mass Notification System (Spotsy Alert) to notify residents of important information. Spotsy Alert provides notifications ranging from emergencies to public events. These notifications come in the form of a text message, phone call, and emails. Users can select the method of notification that meets their needs, and can go to WWW.SPOTSYALERT.COM for more information. The County does have access to override all cable channels for EAS activation. Additionally, the Department of Fire, Rescue, and Emergency Management website has links to multiple websites providing information on emergency preparedness.

Capability Matrix - Spotsylvania County

Capability	Spotsylvania County
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
NFIP/FPM Ordinance	Yes
-Effective FIRM Date	18-February-98
-Substantial Damage Language	Yes
- Certified Floodplain Manager	Yes
- # of Floodprone Buildings	410
- # of NFIP policies	304
- Maintain Elevation Certificates	Yes
- # of Repetitive Losses	0
CRS Rating	No
Stormwater Program	Yes
Building Code Version	USBC 2012 Edition
Full-time Building Official	Yes
- Conduct “As-built” Inspections	Yes
BCEGS Rating	Residential - 3; Commercial - 3
Local Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
- Storm Ready Certified	No
- Weather Radio Reception	Yes; high coverage
- Outdoor Warning Sirens	Yes; 10 mile radius around the North Anna Power Station
-Emergency Notification (R-911)	Yes
-other (e.g., cable over-ride)	Yes- Mass Notification System (Spotsy Alert)
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	No
Property Owner Protection Projects	No
Critical Facilities Protected	No
Natural Resource Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes

Capability	Spotsylvania County
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Source: Data provided by Community.

6.2.5 - Stafford County Capability Assessment

Form of Governance

The County is governed by a seven member, elected Board of Supervisors and administered on a day-to-day basis by a County Administrator and subsequent departmental staff.

Guiding Community Documents

Stafford County has a range of guidance documents and plans for each of their departments. These include a comprehensive plan, public works, and public utilities plans, capital improvement plans, and emergency management plans. The County uses building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. One essential way the region guides its future is through policies laid out in the Comprehensive Plan.

Comprehensive Plan, 2016

- Plans and analysis of the County's transportation, land use, environmental, and public resources.
- Accounts for the County's desire to retain the viability of its agricultural enterprises and heritage; implement a multi-faceted economic development program; establishment of adequate public infrastructure for planned growth and development trends; and improve and enhance both the man-made and natural environment in the County.
- Accounts for urban, suburban, and rural/agricultural land uses in designated corridors.
- Establishes target areas for higher intensity development.

Zoning & Development Standards

- Establishes a regulatory framework for new development.
- Reflects community standards for the appearance of buildings and properties.

Building Codes

The Commonwealth of Virginia is responsible for enacting the Virginia Uniform Statewide Building Code, which the County is responsible for enforcing locally. The Uniform Statewide Building Code is based on the IBC, IRC, and IFPC.

The Building Code Effectiveness Grading Schedule (BCEGS) assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards. Municipalities with well-enforced, up-to-date codes should demonstrate better loss experience, and insurance rates can reflect that. The BCEGS program assigns each municipality a BCEGS grade of 1 (exemplary commitment to building-code enforcement) to 10. The BCEGS grade for Stafford County is presented in the included table.

Flood Management

Stafford County is a participant in the National Flood Insurance Program (NFIP), and makes efforts, through the public meetings and annual letters to individual property owners, to educate citizens on flood insurance topics and policy changes. The County's floodplains are mapped by Flood Insurance Rate Maps (FIRM), which are available to the public and updated with current information as needed. The County has also adopted a floodplain management ordinance meeting federal requirements, which is regularly enforced. The County is also a participant in the Community Rating System (CRS). Further information about the County's floodplain management efforts can be found in the NFI survey included in the appendix of this document.

Public Education

Among the readily available public outreach mechanisms available in Stafford County, the County's website provides County residents with pertinent information, provides updates on County programming and events, and answers several Frequently Asked Questions (FAQs). The County also posts most of its guiding documents, including the Comprehensive Plan, on this site. The County also uses social media contact to expand its public outreach initiatives.

Emergency Preparedness

Stafford utilizes a cable access channel, Reverse911, and Stafford Alert to notify residents of important information. The County does have access to override all cable channels for EAS activation.

Capabilities Matrix - Stafford County

Capability	Stafford County
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
NFIP/FPM Ordinance	Yes
-Effective FIRM Date	February 18, 2015
-Substantial Damage Language	Yes
- Certified Floodplain Manager	Yes
- # of Floodprone Buildings	1,916
- # of NFIP policies	601
- Maintain Elevation Certificates	Yes
- # of Repetitive Losses	11
CRS Rating	8
Stormwater Program	Yes
Building Code Version	USBC 2012 Edition
Full-time Building Official	Yes
- Conduct "As-built" Inspections	Yes

Capability	Stafford County
BCEGS Rating	Residential - 4; Commercial - 4
Local Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Yes
- Storm Ready Certified	No
- Weather Radio Reception	Yes; full coverage
- Outdoor Warning Sirens	No
-Emergency Notification (R-911)	Yes
-other? (e.g., cable over-ride)	Yes-Emergency Broadcast System
GIS system	Yes
-Hazard Data	Yes
-Building footprints	Yes
-Tied to Assessor data	Yes
-Land Use designations	Yes
Structural Protection Projects	No
Property Owner Protection Projects	Yes-Acquisition/Elevation
Critical Facilities Protected	No
Natural Resource Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

Source: Data provided by Community.

GEORGE WASHINGTON
REGIONAL COMMISSION

7:
Mitigation Strategies

7 – MITIGATION STRATEGIES

This section of the Hazard Mitigation Plan describes the most challenging part of any such planning effort, the development of a Mitigation Strategy. It is a process of:

1. Setting mitigation goals,
2. Considering mitigation alternatives,
3. Identifying objectives and strategies, and
4. Developing a mitigation action plan.

In being comprehensive, the development of the strategy included a thorough review of all natural hazards and identifies far-reaching policies and projects intended not only to reduce the future impacts of hazards, but also to assist counties and municipalities achieve compatible economic, environmental, and social goals. In being strategic, the development of the strategy ensures that all policies and projects are linked to established priorities and assigned to specific departments or individuals responsible for their implementation with target completion deadlines. When necessary, funding sources are identified that can be used to assist in project implementation.

The 2017 Update has included a review of previously identified strategies in order to determine progress made and applicability for inclusion in the plan update. Many of the strategies were brought forward into the new plan, but some previously identified actions have now been completed, or have been determined to no longer be applicable based on the updated risks and capabilities of each jurisdiction. As such, each jurisdiction compiled a new set of mitigation strategies that they determined to be the most effective use of their resources. To review these strategies, please refer to section III of this chapter.

7.1 - Planning Process

The hazard mitigation planning process conducted by the committee is a typical problem-solving methodology:

- Describe the problem (Hazard Identification),
- Estimate the impacts the problem could cause (Vulnerability Assessment),
- Assess what safeguards exist that might already or could potentially lessen those impacts (Capability Assessment), and
- Using this information, determine what, if anything, can be done, and select those actions that are appropriate for the community in question (Develop an Action Plan).

When a community decides that certain risks are unacceptable and that certain mitigation actions may be achievable, the development of *goals* and *objectives* takes place. Goals and objectives help to describe what actions should occur, using increasingly narrow descriptors. Initially, long-term and general statements known as broad-based goals are developed. Goals then are accomplished by meeting objectives, which are specific and achievable in a finite time period. In most cases there is a third level, called *strategies,* which are detailed and specific methods to meet the objectives.

The committee discussed regional goals and objectives for this plan at two points in the planning process. First, the committee reviewed strategies expressed in previous version of this plan for compatibility with the most recent local and regional goals and objectives, then met together in January of 2017 to compare strategies with peer communities before making final revisions to each locality's own mitigation strategies.

7.2 - Mitigation Alternatives

In formulating the GWRC's mitigation strategy, a wide range of activities were considered in order to help achieve the general regional goals in addition to the specific hazard concerns of each participating jurisdiction, including the following:

1) The use of applicable building construction standards;
2) Hazard avoidance through appropriate land-use practices;
3) Relocation, retrofitting, or removal of structures at risk;
4) Removal or elimination of the hazard;
5) Reduction or limitation of the amount or size of the hazard;
6) Segregation of the hazard from that which is to be protected;
7) Modification of the basic characteristics of the hazard;
8) Control of the rate of release of the hazard;
9) Provision of protective systems or equipment for both cyber or physical risks;
10) Establishment of hazard warning and communication procedures; and
11) Redundancy or duplication of essential personnel, critical systems, equipment, information materials.

All activities considered by the committee can be classified under one of the following six (6) broad categories of mitigation techniques:

Prevention of Future Risk

Preventative activities are intended to keep hazard problems from getting worse, and are typically administered through government programs or regulatory actions that influence the way land is developed and buildings are built. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventative activities include:

- Planning and zoning
- Building codes
- Open space preservation
- Floodplain regulations
- Stormwater management regulations
- Drainage system maintenance
- Capital improvements programming
- Setbacks for hazard areas
- Use of pervious surfaces

Protection of the Built Environment

Property protection measures involve the modification of existing buildings and structures to help them better withstand the forces of a hazard, or removal of the structures from hazardous locations. Examples include:

- Acquisition and demolition
- Acquisition and relocation
- Structural elevation
- Critical facilities and infrastructure protection
- Retrofitting (e.g., windproofing, floodproofing, seismic design techniques, ignition resistant construction materials, etc.)
- Safe rooms, shutters, shatter-resistant glass
- Insurance
- Impervious surface modifications

Natural Resource Protection

Natural resource protection activities reduce the impact of natural hazards by preserving or restoring natural areas and their protective functions. Such areas include floodplains, wetlands, steep slopes and sand dunes. Parks, recreation or conservation agencies and organizations often implement these protective measures. Examples include:

- Floodplain protection
- Watershed management
- Beach and dune preservation
- Riparian buffers
- Forest and vegetation management (e.g., fire resistant landscaping, fuel breaks, defensible spaces, etc.)
- Erosion and sediment control
- Wetland preservation and restoration
- Habitat preservation
- Slope stabilization

Hazard Modification Through Construction

Structural mitigation projects are intended to lessen the impact of a hazard by modifying the environmental natural progression of the hazard event through construction. They are usually designed by engineers and managed or maintained by public works staff. Examples include:

- Reservoirs
- Dams, levees, dikes, floodwalls, or seawalls
- Diversions, detention, or retention
- Channel modifications
- Storm sewers
- Drainage improvements
- Minor localized flood reduction projects

Emergency Services

Although not typically considered a “mitigation” technique, emergency service measures do minimize the impact of a hazard event on people and property. These commonly are actions taken immediately prior to, during, or in response to a hazard event. Examples include:

- Warning systems
- Evacuation planning and management
- Emergency response training and exercises
- Continuity of operations planning
- Sandbagging for flood protection
- Elevating contents for flood protection
- Installing temporary shutters for wind protection
- Generators and quick-connects

Public Education and Awareness

Public education and awareness activities are used to advise residents, elected officials, business owners, potential property buyers, and visitors about hazards, hazardous areas, and mitigation techniques they can use to protect themselves and their property. Examples of measures to educate and inform the public include:

- Outreach projects
- Speaker series or demonstration events
- Hazard map information
- Real estate disclosure
- Library materials
- School children educational programs
- Hazard expositions

7.3 - Prioritizing Alternatives

Participating communities were asked to review past mitigation strategies, as well as 2017 additions, with an eye toward seven major criteria; Social, Technical, Administrative, Political, Legal, Economic, and Environmental. Using these criteria, the committee selected strategies that would have the greatest impact, be deployed equitably, and use community resources wisely. The table below provides information regarding the review and selection criteria for alternatives.

Review and Selection Criteria for Mitigation Alternatives

Review and Selection Criteria for Alternatives
Social
• Is the proposed action socially acceptable to the community(s)? • Are there equity issues involved that would mean that one segment of a community is treated unfairly? • Will the action cause social disruption?
Technical
• Will the proposed action work? • Will it create more problems than it solves? • Does it solve a problem or only a symptom? • Is it the most useful action in light of other community(s) goals?

Review and Selection Criteria for Alternatives
Administrative
• Can the community(s) implement the action? • Is there someone to coordinate and lead the effort? • Is there sufficient funding, staff, and technical support available? • Are there ongoing administrative requirements that need to be met?
Political
• Is the action politically acceptable? • Is there public support both to implement and to maintain the project?
Legal
• Is the community(s) authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity? • Are there legal side effects? Could the activity be construed as a taking? • Is the proposed action allowed by a comprehensive plan, or must a comprehensive plan be amended to allow the proposed action? • Will the community(s) be liable for action or lack of action? • Will the activity be challenged?
Economic
• What are the costs and benefits of this action? • Do the benefits exceed the costs? • Are initial, maintenance, and administrative costs taken into account? • Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)? • How will this action affect the fiscal capability of the community(s)? • What burden will this action place on the tax base or local economy? • What are the budget and revenue effects of this activity? • Does the action contribute to other community goals, such as capital improvements or economic development? • What benefits will the action provide?
Environmental
• How will the action affect the environment? • Will the action need environmental regulatory approvals? • Will it meet local and state regulatory requirements? • Are endangered or threatened species likely to be affected?

7.4 – Goals for the Region

This plan, and the associated strategies found in this section, are based on four broad goals established in the state-wide hazard mitigation plan:

- **Goal 1:** Identify and implement projects that will eliminate long-term risk, directly reduce impacts from hazards, and maintain continuity of critical societal functions.

- **Goal 2:** Incorporate mitigation concepts and objectives into existing and future policies, plans, regulations, and laws in the Commonwealth.

- **Goal 3:** Improve the quality of the data and analysis used in the hazard identification and risk assessment process in state, local, and university hazard mitigation plans.

- **Goal 4:** Through training, education, and outreach promote awareness of hazards, their risk, and potential mitigation actions in order to increase resiliency.

Community officials should consider these goals when initiating community policies, public investment programs, economic development programs, or community development decisions for their communities.

Regional and Local Mitigation Strategies

The strategies found in the charts below represent individual regional or local actions that can be taken over the next five year period to begin to fulfill the four broad mitigation goals for the GWRC region. Each has been selected and prioritized base on the criteria included above, and is shown along with departmental responsibility and potential funding sources. These strategies should be continually reviewed and updated to best serve local and regional constituents, and should be further reviewed and updated within the five year review cycle as outlined in this plan and according to state and local regulations.

Strategies were ranked by each community with a priority ranking of high, medium or low, with the following meanings:

- High (H) – implement in the short-term
- Medium (M) – implement in the long-term
- Low (L) – implement only as funding becomes available

In addition, the anticipated level of cost effectiveness of each measure was a primary consideration when developing mitigation actions. Because mitigation is an investment to reduce future damages, it is important to select measures for which the reduced damages over the life of the measure are likely to be greater than the project cost. For structural measures, the level of cost effectiveness is primarily based on the likelihood of damages occurring in the future, the severity of the damages when they occur, and the level of effectiveness of the selected measure. Although detailed analysis was not conducted during the mitigation action development process, these factors were of primary concern when selecting measures. For those measures that do not result in a quantifiable reduction of damages, such as public education and outreach, the relationship of the probable future benefits and the cost of each measure was considered when developing the mitigation actions. Each jurisdiction's mitigation strategies can be found in the tables that follow.

7.5 - GWRC Regional Mitigation Action Plan

Mitigation Action Plan - GWRC Region

ID Number	Year	Project Description	Hazards Being Mitigated: Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters	Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
New Strategies for the 2017 Update																
GW-1	2017	Promote the incorporation of mitigation concepts and objectives into local, regional, and state planning processes and documents through local member governments and state lobbying efforts.	X	X	X	X	X	X	X	X	X	GWRC	Local	On-going	Identify local and state policy targets	Medium
GW-2	2017	Encourage member localities to incorporate dam failure inundation mapping into local GIS systems to standardize and quantify the potential impacts of dam failure hazards on life and property.	X					X	X			GWRC	Local	On-going	Identify available dam safety mapping and data	Medium
Ongoing Strategies from 2012 Plan																
GW-3	2006	Establish uniform GIS standards for capabilities and data throughout the GWRC region.	X	X	X	X	X	X	X	X	X	GWRC	Local	On-going	Continued transmission of GIS datasets to central ftp site	Medium
GW-4	2006	Continue to improve regional inter-operable emergency communications and planning by coordinating and sharing GIS and other data.	X	X	X	X	X	X	X	X	X	GWRC	FEMA Unified Hazard Mitigation Assistance Funding	Ongoing	Develop information sharing plan to focus on sharing GIS datasets, MOUs, and IT procurement documents	Medium
GW-5	2006	Refine and make available to the jurisdictions, the current regional critical facilities database maintained by the GWRC. Ensure common definition of critical facilities among the region and map each location using GIS.	X	X	X	X	X	X	X	X	X	GWRC	FEMA Unified Hazard Mitigation Assistance Funding	2017	Define critical facility	Low
GW-6	2006	Improve signage along major interstates and thoroughfares with interactive signs to provide hazard warnings, weather information, road closings, etc. Suggested locations include I-95 and Routes 1, 3, 17, 301, and 610	X	X	X	X	X	X	X	X	X	GWRC/FAMPO	FAMPO Unified Planning Work Program	On-going	Incorporation in LRTP as program recommendation	Low
GW-7	2006	Investigate emergency lane/shoulder improvements for Emergency Services access on all primary roads	X	X	X	X	X	X	X	X	X	GWRC/FAMPO	FAMPO Unified Planning Work Program	On-going	Recommendations in special corridor studies	Low
GW-8	2006	Identify and publicize local evacuation routes throughout the region.	X	X	X	X	X	X	X	X	X	GWRC/FAMPO	FAMPO Unified Planning Work Program	On-going	Incorporation in LRTP as program recommendation	High
GW-9	2006	Identify traffic plan/alternate routes due to closures on primary routes such as 1, 3, 17, 301, and 610	X	X	X	X	X	X	X	X	X	GWRC/FAMPO	FAMPO Unified Planning Work Program	On-going	Recommendations in special corridor studies	Low
GW-10	2006	Evaluate the vulnerability of the region's critical facilities to hazards and make recommendations for improving resiliency; focusing on generator power to shelters.	X	X	X	X	X	X	X	X	X	GWRC	FEMA Unified Hazard Mitigation Assistance Funding	2019	Define critical facility	High

ID Number	Year	Project Description	Hazards Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
GW-11	2006	Review regional compliance with the NFIP on an annual basis and make recommendations where appropriate.	X					X	X			GWRC	FEMA Unified Hazard Mitigation Assistance Funding	Annually	Determine review parameters	High
GW-12	2012	Develop a regional preparedness guide focusing on natural hazards to disseminate to the public.	X	X	X	X	X	X	X	X	X	GWRC	FEMA Unified Hazard Mitigation Assistance Funding	2018	Identify funding source and determine hazards to be included in guide	Low
Strategies Completed or Deleted During 2017 Plan Update																
	2006	Coordinate locally with VDOT on updates to VDOT's Regional Transportation Plans. *(Deleted – not a specific hazard objective, but is a part of GWRC's everyday efforts)*	X	X	X	X	X	X	X	X	X					
	2006	Purchase and place into operation AM radio stations along routes to relay emergency information to motorists during a disaster or emergency. *(Deleted – outdated technology)*	X	X	X	X	X	X	X	X	X					
	2006	Facilitate discussions with neighboring regions on traffic flow for emergency service vehicles. *(Deleted – not a specific objective)*	X	X	X	X	X	X	X	X	X					
	2006	It is recommended to investigate and potentially purchase the equipment required to eliminate radio communication gaps in valleys. *(Completed by member jurisdictions)*	X	X	X	X	X	X	X	X	X					
	2012	Develop a regional special needs registry and plan by 2016. *(Deleted – not a regional priority at this time)*	X	X	X	X	X	X	X	X	X					

7.6.1 - Caroline County Mitigation Action Plan

Mitigation Action Plan - Caroline County

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
Ongoing Strategies from 2012 Plan																
C-1	2006	Investigate safeguards against severe weather including hurricane clips, safe rooms, community shelters, and /or model shelters	X	X	X	X	X	X	X	X	X	Planning Department	Local funding	Ongoing	Identify and compare the cost of the available safeguards.	Medium
C-2	2006	Participate in establishing uniform GIS standards for the region, and in regional sharing of GIS data.	X	X	X	X	X	X	X	X	X	Planning Department	Local funding	Ongoing	Reestablish data sharing repository.	Medium
C-3	2006	Enhance the Caroline Alert system to provide information and warnings to citizens and businesses on specific events throughout the region.	X	X	X	X	X	X	X	X	X	Department of Fire-Rescue and Emergency Management	Local funding	2018	Compile list of potential or desired upgrades	Medium
C-4	2006	Establish a common means of communication, such as one radio frequency or equipment to connect existing radio frequencies, for use by all emergency services providers.	X	X	X	X	X	X	X	X	X	Department of Fire-Rescue and Emergency Management	Local funding	2018	Coordination among user departments.	High
C-5	2012	Evaluate the vulnerability of critical facilities to natural hazards and improve service redundancy to facilities where appropriate.	X	X	X	X	X	X	X	X	X	Department of Fire-Rescue and Emergency Management	Local funding	2018	Compile a list of facilities to be evaluated and the capabilities considered crucial for their operation.	High
C-6	2012	Develop an Earthquake preparedness, response, and recovery brochure for distribution at public outreach events, i.e. county fair.				X						Department of Fire-Rescue and Emergency Management	HMGP grant funding	2018	Develop outreach materials, or identify appropriate outreach materials for dissemination.	Medium
C-7	2012	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	X	X	X	X	X	X	X	X	X	Department of Fire-Rescue and Emergency Management	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium
C-8	2012	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.						X	X			Department of Fire-Rescue and Emergency Management	Local funding	Ongoing	Establish a schedule of review and review committee (if necessary).	Medium

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
C-9	2012	Conduct annual outreach to owners of all flood-prone properties, including NFIP insured, uninsured, and any repetitive loss properties, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.						X	X			Planning Department	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination.	Medium
C-10	2012	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.						X	X			Planning Department	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Identify priority flood-prone structures.	Medium
Strategies Completed or Deleted During 2017 Plan Update																
	2006	Establish a minimum standard for GIS capabilities and data throughout the region as jurisdictions being to add GIS to their current hazard mitigation capabilities. *(Completed)*														
	2006	Establish a clearinghouse of GIS data for all jurisdictions. *(Completed)*														
	2006	Improve the flexibility of the transportation network through coordination with the Virginia Department of Transportation (VDOT) and neighboring regions. *(Deleted – regional responsibility)*														

7.6.2 - City of Fredericksburg Mitigation Action Plan

Mitigation Action Plan - City of Fredericksburg

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
Ongoing Strategies from 2012 Plan																
F-1	2006	Investigate the vulnerability of City owned facilities and infrastructure to natural hazards.	X	X	X	X	X	X	X	X	X	Building Services Division	Local funding	Ongoing	Identify all vulnerable priority structures	Low
F-2	2012	Conduct annual outreach to owners of all flood-prone properties, including NFIP insured, uninsured, and any repetitive loss properties, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.						X	X			Planning Services Division	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination.	Medium
F-3	2012	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.						X	X			Building Services Division	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Identify all priority flood-prone structures.	Medium
F-4	2012	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	X	X	X	X	X	X	X	X	X	Building Services Division	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Low
F-5	2012	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.						X	X			Planning Services Division	Local funding	Ongoing	Establish a schedule of review and review committee (if necessary).	Medium
F-6	2012	Develop hazard loss processes that influence the way land and buildings are developed and built.	X	X	X	X	X	X	X	X	X	Building Services Division	Local funding	Ongoing	Establish preliminary standards for building development that meet hazard loss prevention expectations	Low
F-7	2006	Identify all critical facilities and map their locations using GIS.	X	X	X	X	X	X	X	X	X	Information Technology Department	Local funding	Ongoing	Identify 50% of critical facility buildings using GIS	Medium
F-8	2012	Identify priorities for protection among critical facilities identified in the hazard mitigation plan as well as methods for protection against natural hazards, including the retrofitting of structures for quick external power generator hook up.	X	X	X	X	X	X	X	X	X	Building Services Division	Local funding	Ongoing	Install generators in buildings identified as needing them	Medium

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
Strategies Completed or Deleted During 2017 Plan Update																
	2006	Investigate safeguards against severe weather including hurricane clips, safe rooms, community shelters, and/or model shelters. *(Completed; 2014)*	X	X	X	X	X	X	X	X	X					
	2006	Establishing a common means of communication, such as one radio frequency or equipment to connect existing radio frequencies, for use by all emergency services departments in the GWRC region. *(Completed; 2016)*	X	X	X	X	X	X	X	X	X					
	2012	Foster interdepartmental relationships for hazard mitigation across the City. *(Completed – included in new city procedures)*	X	X	X	X	X	X	X	X	X					
	2012	Study the feasibility for construction of barriers or structures to reduce the impact of hazards / floods. *(Completed; 2013– no additional structures recommended at this time)*						X								
	2012	Develop an earthquake preparedness guide and distribute at local events (i.e. Fredericksburg Agricultural Fair) *(Completed; 2015)*				X										

7.6.3 - King George County Mitigation Action Plan

Mitigation Action Plan - King George County

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
Ongoing Strategies from 2012 Plan																
KG-1	2006	Evaluate County/region interoperability problems, propose corrective actions, and seek grants to fund interoperable communications.	X	X	X	X	X	X	X	X	X	Department of Fire Rescue and Emergency Services /Sheriff's Office	DHS, AFG/SHSP grants	Ongoing	Work at regional and local level to identify gaps and look for best practices to improve coverage.	Medium
KG-2	2012	Partner with schools, churches, civic groups, and volunteers to communicate on emergency issues and increase their involvement in emergency planning and response.	X	X	X	X	X	X	X	X	X	Department of Fire Rescue and Emergency Services	County	Ongoing	Request feedback from stakeholders on effectiveness of outreach.	Medium
KG-3	2012	Continue to expand the LEPC to include more County businesses and associations, and continue to make it an "all hazards" organization.	X	X	X	X	X	X	X	X	X	Department of Fire Rescue and Emergency Services	County	Ongoing	Local businesses identified and contacted and informed of what the LEPC is and how they can participate.	Medium
KG-4	2012	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate. Conduct outreach to affected property owners as needed.						X				Department of Fire Rescue and Emergency Services	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	All flood-prone structures identified and mapped on GIS, and proposed actions determined to mitigate the risk of floods.	Medium
KG-5	2012	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc. Continue to assess County's critical infrastructure to natural hazards and improve service redundancy where appropriate.	X	X	X	X	X	X	X	X	X	Department of Fire Rescue and Emergency Services	FEMA Unified Hazard Mitigation Assistance funding / local funding	Ongoing	Critical facilities evaluated to identify weaknesses and electrical deficiencies, and plans established to upgrade them as funds allow.	Medium
KG-6	2012	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.						X	X			Department of Fire Rescue and Emergency Services	Local funding	Ongoing	Identified all permitted projects in 100 year flood plain, and first annual review of Floodplain Ordnances completed.	Medium
KG-7	2012	Conduct annual outreach to owners of all flood-prone properties, including NFIP insured, uninsured, and any repetitive loss properties, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.						X	X			Department of Fire Rescue and Emergency Services	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	2013 - FEMA-listed repetitive loss property in the County identified, potential mitigation actions identified, and contacts made with property owners to discuss auctions.	Medium

ID	Year	Project Description	Hazard Being Mitigated: Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters	Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
New Strategies for the 2017 Update																
KG-8	2017	Provide technical assistance to the Fairview Beach Community in their efforts to secure grant funds to rebuild the Potomac River shoreline to protect Fairview Drive and County critical infrastructure.					X	X	X		X	Department of Fire Rescue and Emergency Services	Grant Funds	Ongoing	Positive grant review.	Medium
KG-9	2017	Preplan all Target hazards, critical infrastructure, and large commercial properties into new Computer Aid Dispatch system lessen the impact to environment and public in the event of an emergency situation.	X		X	X	X	X	X	X	X	Department of Fire Rescue and Emergency Services / Sheriff's Office	Local funding	Ongoing	All Public Schools and Phase 1 Tier II sites have been pre-planned and uploaded in the CAD.	High
KG-10	2012	Improve County policies, codes, and regulations to reduce or eliminate impacts of known natural hazards.	X	X	X	X	X	X	X	X	X	Department of Fire Rescue and Emergency Services & Community Development	County	Ongoing	Identify County policies, codes, and regulations associated with impacts of natural hazards.	Medium
Strategies Completed or Deleted During 2017 Plan Update																
	2012	Evaluate the Fairview Beach/Company 3 facility to identify safety, fire, and building deficiencies, develop a plan for their correction, and correct deficiencies. *(Complete)*	X	X	X	X	X	X	X	X	X					
	2012	Conduct more enforcement and inspections related to building and fire codes, and Virginia codes. *(Deleted – not feasible or specific enough for continued inclusion)*	X	X	X	X	X	X	X	X	X					
	2012	Establish a policy that encourages builders of new homes in the County to provide connections for home generators. *(Deleted – not feasible or specific enough for continued inclusion)*	X	X	X	X	X	X	X	X	X					
	2012	Provide funding to Community Development for County flyover to improve mapping in disaster preparedness activities. *(Deleted – not feasible or specific enough for continued inclusion)*	X	X	X	X	X	X	X	X	X					
	2012	Establish a hotline for citizens to call for non-emergency information during a disaster. *(Complete)*	X	X	X	X	X	X	X	X	X					
	2012	Develop additional ways (both web-based and paper) to educate the public, businesses, e.g., EM website, Twitter, Facebook, AM radio stations, and newspapers. *(Complete)*	X	X	X	X	X	X	X	X	X					

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
	2012	Develop/purchase additional signage for use at all designated emergency shelters. *(Deleted – not feasible or specific enough for continued inclusion)*	X	X	X	X	X	X	X	X	X					
	2012	Complete purchase and installation of new electronic emergency notification sign at Company 1 and explore signs for other companies. (*Complete)*	X	X	X	X	X	X	X	X	X					
	2012	Investigate and implement structural projects that will reduce or eliminate the effects of natural hazards on public and private property in the County. *(Deleted – not feasible or specific enough for continued inclusion)*	X	X	X	X	X	X	X	X	X					

7.6.4 - Spotsylvania County Action Plan

Mitigation Action Plan - Spotsylvania County

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
Ongoing Strategies from 2012 Plan																
SP-1	2006	Develop advisory development design standards based upon FIREWISE principles and defensible space.			X							FREM/DOF	Local	Ongoing	Develop written guidance.	Medium
SP-2	2006	Participate in establishing uniform GIS standards for the region, and in regional sharing of GIS data.	X	X	X	X	X	X	X	X	X	GWRC/ GIS	Local funding	Ongoing	Reestablish data sharing repository.	Medium
SP-3	2006	Improve the flexibility of the transportation network through coordination with the Virginia Department of Transportation (VDOT) and neighboring regions	X		X	X	X	X	X	X	X	VDOT/ FAMPO/ Planning	Federal/ State/ Local	Ongoing	Coordination is occurring	Medium
SP-4	2006	Investigate and potentially purchase the equipment required to eliminate radio communication gaps in valleys	X	X	X	X	X	X	X	X	X	FREM/RPAC-I	Federal / State / Local	Ongoing	Funding is available	Medium
SP-5	2012	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.						X	X			DCR/ Spotsylvania Code Compliance	Local funding	Ongoing	Establish a schedule of review and review committee (if necessary).	Medium
SP-6	2012	Conduct annual outreach to owners of all flood-prone properties, including NFIP insured, uninsured, and any repetitive loss properties, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.						X	X			DCR/ Spotsylvania Code Compliance with FREM	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination.	Medium/Low
SP-7	2012	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.						X				DCR/ Spotsylvania Code Compliance with FREM	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Identify all priority flood-prone structures.	Medium/Low
New Strategies for the 2017 Update																
SP-8	2017	Complete National Weather Service Storm Ready Program. Storm ready aids in preparing for your community's increasing vulnerability to extreme weather and water events.						X	X	X	X	FREM & National Weather Service	Local / Federal	2018	Identify the relevant information to be included, and the events that they are to be presented/distributed at.	Medium

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
SP-9	2017	Continue to establish common means of communication with neighboring emergency services providers on P25 communications systems.	X	X	X	X	X	X	X	X	X	FREM/RPAC-I	Federal/ State/ Local	Ongoing	Coordination is occurring	Medium
SP-10	2017	Review building projects for compliance with the Uniform Statewide Building Code consistent with Section 36-98 of the Code of Virginia.	X	X	X	X	X	X	X	X	X	Spotsylvania County Building Department	Development review fees (local)	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium
SP-11	2017	Complete county-wide studies of impounding structures and break inundation zones where applicable, consistent with the Code of Virginia 10.1-606.2.	X					X				DCR/ Spotsylvania Code Compliance/ FREM/ GIS	Dam Ownership	2025	Identify all remaining impounding structures to have inundation zones mapped consistent with requirements established by the Code of Virginia 10.1-606.2.	High
SP-12	2017	Develop a county-wide Geological Mapping Study. Results of the study can influence future updates of the County Comprehensive Plan and its Future Land Use Map given potential impacts of subsurface geology on ground stability, structural stability, mineral resources and economic opportunities, groundwater recharge and aquifer protection.				X	X	X				Planning/ DMME/ Spotsylvania Code Compliance	TBD	2025	Determine study parameters	Medium
SP-13	2017	Conduct and complete a comprehensive Spotsylvania County Flood Insurance Rate Map (FIRM) update.						X	X			FEMA/ Code Compliance/ GIS	FEMA	2025	Discovery Meeting and Report	High
SP-14	2017	Install generator-ready hookups for quick-connections in critical infrastructure locations such as all public safety facilities, schools (public and private), and other facilities critical to civic resiliency. Promote installation of generator-ready hookups to complementary business operations that can assist public and emergency service needs in disaster scenarios including but not limited to retail fuel stations, grocery and convenience stores, care facilities (adult and child), transportation depots. Provide education and identify potential funding sources available to offset the costs of such hookups.				X			X	X	X	FEMA/ FREM/ Planning	TBD	Ongoing	Establish as Comprehensive Plan goal.	Medium
SP-15	2017	Establish a secondary Emergency Operations Center (EOC) for use in the event that the primary EOC is inoperable. Provide necessary equipment and resources to facilitate the operation of the back-up EOC.	X	X	X	X	X	X	X	X	X	FREM/ Information Services/ Emergency Communications	TBD	2022	Identify funding and Core Capabilities necessary to manage disaster response.	High
Strategies Completed or Deleted During 2017 Plan Update																
	2006	Develop a regional public awareness program. *(Deleted – moved to regional responsibility)*	X	X	X	X	X	X	X	X	X					
	2006	Develop a Weather Spotter program. *(Deleted – revised to include Storm Ready Program – see XXX)*						X	X	X	X					

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
	2012	Develop and conduct an education campaign on Earthquake Safety *(Deleted – moved to regional responsibility)*				X										
	2012	Develop an emergency preparedness guide for distribution at public events. *(Deleted – moved to regional responsibility)*	X	X	X	X	X	X	X	X	X					

7.6.5 - Stafford County Action Plan

Mitigation Action Plan - Stafford County

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
Ongoing Strategies from 2012 Plan																
ST-1	2006	Conduct annual outreach to owners of all flood-prone properties, including NFIP insured, uninsured, and any repetitive loss properties, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.						X	X			Planning and Zoning / Emergency Management (FR)	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Annually prepare and disseminate outreach materials regarding reducing risk to those in flood prone areas.	Medium
ST-2	2006	Develop a process and procedure (specifically adopting best practices such as the Firewise Community Recognition Program) for protecting and making the County less susceptible to the effects of wildfire.			X							Fire and Rescue Department	Local funding	Ongoing	Identify and document the County wildland urban interface areas by conducting a wildfire risk assessment, form a board or committee, and create an action plan based on the assessment.	Medium
ST-3	2006	Investigate the development of a tree-trimming program to protect life and property from falling debris during high wind events. Determine feasibility of partnering with local contractors VDOT, local utilities, and development contractors.							X	X	X	Parks, Recreation and Community Facilities / Public Works	Local funding	2018	Develop a notification policy and prioritized list of work that needs to be done, and the budget to do it with. Reach out to local vendors for a price estimate.	Low
ST-4	2006	Participate in establishing uniform GIS standards for the region, and in regional sharing of GIS data.	X	X	X	X	X	X	X	X	X	Planning Department Information Technology Department	Local funding	Ongoing	Reestablish data sharing repository.	Medium
ST-5	2012	Upgrade aging equipment and technologies in the EOC.	X	X	X	X	X	X	X	X	X	Emergency Management (FR) / Information Technology Department	EMPG	Ongoing	Conduct a current capabilities assessment of the EOC and determine which equipment needs to be replaced/updated. Include priorities for upgrades.	High

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
ST-6	2012	Evaluate how the ECC's ability to manage surge capacity during an emergency can be augmented.	X	X	X	X	X	X	X	X	X	Emergency Management (FR)	Local funding	Ongoing	Communications manuals have been developed that outline processes and procedures. MOU is established with Fredericksburg to take over ECC functions should Stafford's ECC become inoperable	Medium
ST-7	2012	Develop Stand-by contracts and MOUs with private companies for surge logistical support during an emergency; specifically, emergency energy supplies to critical facilities.	X	X	X	X	X	X	X	X	X	Planning/Public Works / Emergency Management	Local funding	Ongoing	Identify a list of critical facilities that are in need of such support and a list of the vendors in the area that can provide such services.	Medium
ST-8	2012	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.						X	X			Planning/Emergency Management	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Annually identify all priority flood zone structures.	Medium
ST-9	2012	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	X	X	X	X	X	X	X	X	X	Public Works/Code Enforcement	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium
ST-10	2012	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.						X	X			Planning	Local funding	Ongoing	Establish a schedule of review and review committee (if necessary). develop an annual report for program evaluation.	Medium
ST-11	2012	Develop an Earthquake/Landslide Awareness course for all County and School Staff.				X	X					Emergency Management (FR)/ Public Works	LEMPG	Ongoing	Participate in annual Great Southeast Shake-Out Earthquake drill / Exercise and evaluate effectiveness.	Low
New Strategies for the 2017 Update																
ST-12	2017	Seek Federal and State funding sources to assist neighborhoods and private property owners to make required dam safety improvements for high hazard dams.	x					x	x			Public Works / Emergency Management	Federal, State and Local Funding	Ongoing	Identify all high hazard dams that are non-complaint. Seek engineering cost estimates for required improvements	Medium

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
Strategies Completed or Deleted During 2017 Plan Update																
	2006	Identify all critical facilities using GIS. *(Completed)*	X	X	X	X	X	X	X	X	X					

7.6.6 - Town of Bowling Green Action Plan

Mitigation Action Plan - Town of Bowling Green

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority - (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
Ongoing Strategies from 2012 Plan																
B-1	2012	Evaluate the vulnerability of critical facilities to natural hazards and identify a shelter facility within the Town limits	X	X	X	X	X	X	X	X	X	Town Administrator / County Department of Fire and Rescue / Emergency Management	Local funding	2018	1. Identify the facilities to be identified and the criteria that they must meet. 2. Establish special needs and transportation resources registry	High
B-2	2012	Improve current stormwater management system by establishing an adequate maintenance program to clear storm drains.						X	X		X	Public Works	Local funding / Grant funding	2018	1. Develop a Cooperative Working Agreement with VDOT 2. Identify maintenance to be performed, maintenance scheduling, and parties responsible	High
B-3	2012	Investigate establishing a secondary electrical power feed	X	X	X	X	X	X	X	X	X	Town Administrator / Power Suppliers	Local Funding	2020	Identify resources for establishing a secondary electrical supply, and conduct a cost analysis	Medium
B-4	2012	Evaluate critical facilities and shelters to evaluate their resistance to all hazards and make recommendations on ways they can be strengthened or hardened (specifically as they relate to back-up power and electrical systems).	X	X	X	X	X	X	X	X	X	Town Administrator / Caroline County Dept of Fire and rescue / Emergency Management	Local funding	2018	1. Identify the type of backup to be implemented and which facilities they are to be installed in. 2. Identify potential contractors that can provide this service, and obtain a written estimate.	Medium
B-5	2012	Investigate the feasibility of implementing an outdoor warning system using sirens and visual notification systems.	X	X	X	X	X	X	X	X	X	Emergency Management (FR)	HMGP funding	2020	1. Identify the types of systems available and conduct cost/benefit analysis 2. Identify parties responsible for implementation, maintenance, and operation	Medium
B-6	2012	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.						X	X			Emergency Management (FR)/County Public Information	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination.	Medium

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority - (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
B-7	2012	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.						X	X			Planning/Emergency Management	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Identify all priority flood-prone structures.	Medium
B-8	2012	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	X	X	X	X	X	X	X	X	X	Public Works/Code Enforcement	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium
B-9	2012	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.						X	X			Planning	Local funding	Ongoing	Establish a schedule of review and review committee (if necessary).	Medium
Strategies Completed or Deleted During 2017 Plan Update																
	2012	Develop an earthquake preparedness brochure, for distribution at major public events around Bowling Green. *(Deleted – task to be completed by GWRC)*				X										

7.6.7 - Town of Port Royal Action Plan

Mitigation Action Plan - Town of Port Royal

ID	Year	Project Description	Hazard Being Mitigated									Lead/Support Agency	Funding Source	Target Completion Date	Interim Measure of Success	Priority – (High, Medium, Low)
			Dam Failure	Drought & Extreme Heat	Wildfires	Earthquakes	Sinkholes & Landslides	Flooding & Erosion	Hurricanes & Thunderstorms	Tornadoes	Winter Storms & Nor'easters					
Ongoing Strategies from 2012 Plan																
P1	2012	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.						X	X			Emergency Management (FR)/County Public Information	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination.	Medium
P2	2012	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.						X	X			Planning/Emergency Management	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Identify all priority flood-prone structure.	Medium
P3	2012	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	X	X	X	X	X	X	X	X	X	Public Works/Code Enforcement	FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium
P4	2012	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.						X	X			Planning	Local funding	Ongoing	Establish a schedule of review and review committee (if necessary).	Medium
Strategies Completed or Deleted During 2017 Plan Update																
	2012	Develop an Earthquake preparedness, response, and recovery brochure for distribution at public outreach events. *(Deleted – task to be completed by GWRC)*				X										

GEORGE WASHINGTON
REGIONAL COMMISSION

8:
Monitoring, Evaluation & Update

8 – PLAN MONITORING, EVALUATION, AND UPDATE

The long-term success of the George Washington Regional Commission's mitigation plan is directly correlated with its routine monitoring, evaluation, and updating. This process ensures that the plan remains up to date and is retained as a useful tool for preventing and mitigating damages from known hazards.

8.1 - Adoption

<<<< LOCALITY ADOPTION INFORMATION TO BE INSERTED AS AVAILABLE >>>>

8.2 - Implementation

Upon adoption, the plan faces its biggest test: implementation. While this plan puts forth many worthwhile recommendations, which actions to undertake first will be the first decision that the George Washington Regional Commission and its participating communities face.

Funding of mitigation strategies is always a critical issue when it comes to implementation. Therefore, pursuing low or no-cost high-priority recommendations may be one approach that a community chooses to take. An example of a low-cost, high-priority recommendation would be to install flood level markers on bridges to warn of high water levels.

Another implementation approach is to prioritize those actions that can be completed in a relatively short amount of time. Being able to publicize a successful project can build momentum to implement the other parts of the plan. An example of an effective but easy-to-implement strategy is to participate in the National Weather Service's *StormReady* program.

Monitoring funding opportunities should be done simultaneously with the implementation effort. Funding can be leveraged to implement some of the more costly recommendations. The following section, *Integration*, discusses other areas of planning and growth that may present opportunities for accomplishment of multiple planning goals, and potential funding sources. Other funding opportunities should also be pursued such as pre- and post-disaster funds, special district budgeted funds, state or federal ear-marked funds, and grant programs, including those that can serve or support multi-objective applications.

8.3 - Integration

It is important to the long-term implementation of the plan that the underlying principles of this Hazard Mitigation Plan are incorporated into other community plans and mechanisms, including:

- Comprehensive Planning
- Zoning Ordinances
- Capital Improvement Program Budgeting
- Emergency Operations Plans
- Disaster Recovery Plans

The capability assessment section of this plan provides insight into the current comprehensive plans for each community. Planners and emergency managers for each jurisdiction will work to ensure that the appropriate information from this plan is incorporated into subsequent comprehensive plan updates. Mitigation goals and strategies related to community education and long-range planning are especially important comprehensive plan components.

Each locality's zoning ordinance is its primary tool for regulating development and implementing long-range land use goals. Hazard mitigation strategies should be weighed by each locality as they review and update necessary zoning regulations, including the potential inclusion of flood zone overlay districts, minimization of impervious surfaces, required stormwater conveyances, and other site improvements.

Projects that require large investments, such as acquisition or road retrofits, are candidates for inclusion in capital improvement plans where grant funds are unavailable, or where local matching funds are required. It will be important to constantly monitor funding opportunities that can be utilized to implement some of the higher cost recommended actions. Funding opportunities that can be monitored include special pre- and post-disaster funds, special district budgeted funds, state or federal ear-marked funds, and various grant programs.

Locally available emergency operations plans and/or disaster recovery plans should also incorporate mitigation strategies as they relate to emergency responders' work during and immediately after a natural disaster. Mitigation features may include provisions for necessary equipment, training, or facilities improvements to aid first responders as they address hazards.

Mitigation is most successful when it is incorporated within the day-to-day functions and priorities of government. This integration is accomplished by a constant effort to network and to identify and highlight the multi-objective, "win-win" benefits to each program, the communities, and their constituents. This effort is achieved through monitoring agendas, attending meetings, and sending memos.

With adoption of this plan, the GWRC communities will attempt to:

- Pursue the implementation of the high-priority, low/no-cost recommended actions.
- Keep the concept of mitigation in the forefront of community decision-making by identifying and stressing the recommendations of the Hazard Mitigation Plan when other community goals, plans and activities are discussed and decided upon.
- Maintain a constant monitoring of multi-objective, cost-share opportunities to assist the participating communities in implementing the recommended actions of this plan for which no current funding or support exists.

In addition, the communities of the George Washington Regional Commission remain committed to the National Flood Insurance Program. They will continue to enforce floodplain regulations and undertake other actions to remain in compliance with the program.

8.4 - Public Involvement

Public participation in guiding community documents is an important part of the planning process. It allows community residents to recognize, evaluate, and vet the actions of its government. The construction of this document made provisions for public input and comments, as outlined in Section 3.

As this plan is used by member localities and regional authorities, and as the plan is reviewed and updated in the future, it will remain vital that the public has an opportunity to participate in mitigation planning. The Regional Hazard Mitigation Plan will remain publicly available on the website of the George Washington Regional Commission. Public input will be welcomed on the document at any time by contacting GWRC staff. To further involve the public in the maintenance, evaluation, and revision process, one or all of the following may also be considered:

- Advertising meetings of the advisory committee in the local newspaper, public bulletin boards, and/or municipal or county office buildings;
- Designating willing and voluntary citizens and private sector representatives as official members of the committee's mitigation plan steering committee;
- Utilizing local media to update the public of any maintenance and/or periodic review activities taking place;
- Using the jurisdiction's website to advertise any maintenance and/or periodic review activities taking place; and
- Keeping copies of the Plan in public libraries.

8.5 - Monitoring & Maintenance

Plan Maintenance requires an on-going effort to monitor and evaluate the implementation of the plan, and to update the plan as progress, roadblocks, or changing circumstances are recognized.

The George Washington Regional Commission will be responsible for monitoring this plan. Each participating City Manager, County Administrator, or Town Manager will be responsible for appointing one or more representatives (e.g. Emergency Coordinator or Planning Director) to a group convened by the GWRC. It is expected that the group convened by the Planning District Commission will function as an adjunct to the Regional Emergency Managers Group that already meets on a regular basis.

Annual Review

The GWRC will make an annual request to the working group representatives for an update to be provided by January 31 of each year on the progress of the implementation of their respective mitigation Action Plans. These updates will begin in 2018 and will include corrective action plans if needed based on the evaluation criteria set by the working group. The annual progress reports will be consolidated by GWRC and shared with the Virginia Department of Emergency Management.

The GWRC, in coordination with the working group, will determine annually if an update of the plan is needed and the mechanism for doing so. 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 (and/or annexation),
- New state/federal laws, policies, or programs, and/or
- Changes in resource availability.

Five Year Review

At a minimum, the plan update will be initiated by the GWRC no less than four years after plan adoption; the GWRC will seek grant funding no less than three years after plan adoption. A comprehensive plan review will be completed and adopted no less than five years after the adoption of this plan review.

Disaster Declarations

A major event, such as a Presidentially-declared disaster, may trigger a need to review the plan. If such an event occurs in the GWRC region, the working group will coordinate to determine how best to review and update the plan. The updating of the plan will be by written changes and submissions, as the GWRC communities and the working group deem appropriate and necessary. Major changes to the plan will be submitted to the state and to FEMA.

Public notice will be given and public participation will be invited, at a minimum, through available web postings and press releases to the local media outlets, primarily newspapers and radio stations. In addition, the Region will keep information about the plan on its website and displayed in its office. The participating jurisdictions will continue to use the plan as a resource in developing new plans and community preparedness information; they will discuss the plan at public presentations and seek input continuously during the next planning cycle.

Evaluation of progress can be achieved by monitoring changes in the vulnerability identified in the plan. Changes in vulnerability can be identified by noting:

- Lessened vulnerability as a result of implementing recommended actions,
- Increased vulnerability as a result of failed or ineffective mitigation actions, and/or,
- Increased vulnerability as a result of new development (and/or annexation).

Updating of the plan will be by written changes and submissions, as the George Washington Regional Commission communities and the working group deem appropriate and necessary.

GEORGE WASHINGTON
REGIONAL COMMISSION

Appendix

Example Emailed Meeting Invitation:

From: Tim Ware
ware@gwregion.org

Sent: Tuesday, June 28, 2016 8:46 AM

Subject: Hazard Mitigation Kick-off meeting

Good Morning,

The George Washington Regional Commission is beginning its 5-year update of the region's Hazard Mitigation Plan. This plan will help localities better understand the natural hazards they face, and the strategies available to mitigate those hazards. This document is required in order for our local governments to qualify for pre-disaster planning grants or to obtain disaster-related funding in the aftermath of a natural disaster.

Please join us for a kickoff meeting to discuss plan expectations and schedule.

Date:

Tuesday, July 12th, 2016

Time:

11am-12pm

Location:

Mary Washington Healthcare's
Fick Conference Center
1301 Sam Perry Boulevard
Fredericksburg, VA 22401

Thanks and hope to see you there on the 12th.

Tim Ware

Executive Director
George Washington Regional Commission

Example Public Release:

George Washington Regional Commission 2017 Hazard Mitigation Plan

Summary

The George Washington Regional Commission and its member localities in collaboration with The Berkley Group have been leading an effort to update the Regional Hazard Mitigation Plan. This Plan serves two roles within the Region. First, it identifies natural hazards that pose a threat to the safety, health, and economy of the George Washington Region (including Spotsylvania County), as well as steps that can be taken to reduce the impact of these natural hazards in the future, helping communities get back on their feet and back to normal lives as quickly and easily as possible.

Second, this Plan ensures the Region's compliance with the Disaster Mitigation Act (DMA) of 2000, which requires that local governments develop natural hazard mitigation plans in order to qualify for both pre-disaster and post-disaster grant opportunities.

Hazard Mitigation is the sum of the many actions that can be taken at the local and regional level, setting goals, developing strategies, and outlining tasks and schedules to reduce or eliminate long-term risk to human life and property from a variety of natural hazards. In preparing this plan, the GWRC and its member localities including: City of Fredericksburg; Caroline County; King George County; Spotsylvania County; Stafford County; Town of Bowling Green; Town of Port Royal, have identified natural hazards that pose a potential threat; determined the likely impacts of those hazards; assessed vulnerability to the studied hazards, as well as the Region's current capability to address those hazards; set mitigation goals; and determined and prioritized appropriate strategies that can lessen the potential impacts of hazard events.

Each of the chapters contained herein has been updated for 2017 to reflect currently available information and up to date local mitigation strategies. Changes include updates to the hazards that have occurred, review and revision of current capabilities, review and update of the previous plan's mitigation strategies, as well as reconsideration of the overall region's mitigation goals and strategies.

Seeking Your Input

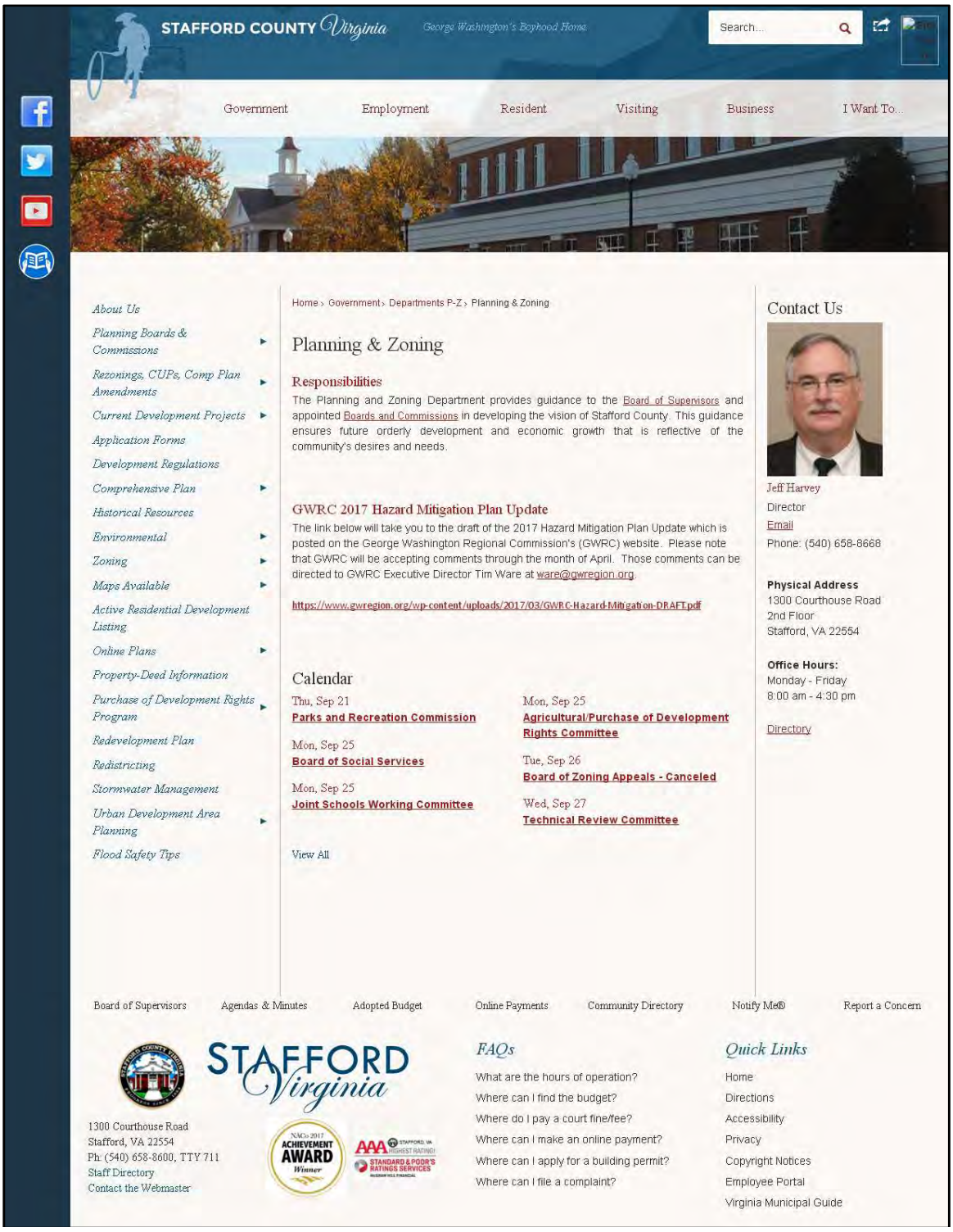
As part of the pre-adoption process, member localities have been asked to post the draft plan for public review and comment through the end of April, 2017. The DRAFT Plan is hosted on the George Washington Regional Commission's website accessible via the following link:

DRAFT 2017 Regional Hazard Mitigation Plan

Public comments pertaining to the Plan are to be directed to ware@gwregion.org or by mail to: George Washington Regional Commission at 406 Princess Anne Street, Fredericksburg, VA 22401.

Example Public Access Television Notice:

Example Web Page Inclusion:



NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: CAROLINE COUNTY, VA

1. FLOODPLAIN IDENTIFICATION AND MAPPING			
Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	Yes	Available in the Caroline County Department of Planning and Community Development (DPCD). FIRMs are available on-line in the public Caroline County GIS.
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	Yes	April 12, 2016
c. Does the municipality support request for map updates?	If yes, state how.	Yes	As required by the Model Floodplain Ordinance promulgated by the Department of Conservation and Recreation,
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	Yes	No recent documentation of the preparation of such information have been provided to this office. However, such information will be provided to FEMA as required by Section 45-20 of the Caroline County Code, adopted, as required, by the Model Floodplain Ordinance promulgated by the Virginia Department of Conservation and Recreation.
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	Yes	Section 45-12 (Use and interpretation of FIRMs) and 45-19 (Interpretation of District Boundaries), adopted as required by the Model Floodplain Ordinance adopted by the Virginia Department of Conservation and Recreation are utilized within the limits of our statutory authority in rendering such determinations.
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	Yes	DPCD

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	Yes	April 12, 2016
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	Yes	DPCD
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	Yes	DPCD
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Yes	DPCD/Department of Building Inspections (Bldg)
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Yes	DPCD
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Yes	DPCD/Bldg reviews/inspects approved development projects for compliance, issues/inspects land disturbing permits, coordinates with VaDEQ on stormwater permitting and investigates complaints/takes enforcement action if necessary. Section 45-22 (Permit and Application Requirements) and 45-23 (General Standards), 45-24 (Elevation and Construction Standards) and 45-28 (Violations and penalties), adopted as required by the Model Floodplain Ordinance promulgated by the Virginia Department of Conservation and Recreation are utilized as reuired.

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	No	

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	No	
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	No	
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	No	

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: ____CITY OF FREDERICKSBURG__

1. FLOODPLAIN IDENTIFICATION AND MAPPING			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	Yes	
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	Yes	
c. Does the municipality support request for map updates?	If yes, state how.	Yes	By providing community support for the request
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	Yes	Data, if available would be shared
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	No	
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	Yes	

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	Yes	
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	Yes	Building & Development Services and Planning Services Departments
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	Yes	
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Yes	Building & Development Services and Planning Services Departments
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Yes	Building & Development Services
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Yes	Issue Letter of Violation

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	Yes	Consideration of participation in the CRS Program

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	Yes	Website
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	Yes	Website
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	No	Website

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: KING GEORGE COUNTY

1. FLOODPLAIN IDENTIFICATION AND MAPPING			
Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	Yes	
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	Not sure	Ordinance was last updated February 18, 2015
c. Does the municipality support request for map updates?	If yes, state how.	NA?	Not sure we have ever had one.
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	NA?	Not sure this has ever come up.
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	Yes	Letter.
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	No	

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	Yes	Adopted, February 18, 2015
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	Yes	If applicable. Department of Community Development
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	Yes	Department of Community Development
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Yes	Department of Community Development
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Yes	Department of Community Development
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Yes	The Department of Community Development makes this part of their review process for new building and zoning permits. We have not had any violations.

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	No	

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	Yes	Website, letters and open houses when there are major changes.
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	Yes	Website, letters and open houses.
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	Yes	Helping with FIRMS and FEMA contacts.

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: _____SPOTSYLVANIA COUNTY, VA_____

1. FLOODPLAIN IDENTIFICATION AND MAPPING			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	Yes	On the County's GIS system accessible through the County Website.
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	Yes	Last one provided 1998
c. Does the municipality support request for map updates?	If yes, state how.		None offered until now.
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.		Never had the opportunity to do so and have received no notice
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	Yes	GIS mapping and potential differences to be presented to FEMA for LOMR
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	Yes	All documents sent to us are scanned and placed into electronic files.

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	Yes	
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	No	There are no permits authorized within the Flood hazard area without appropriate studies to prove no increase in the 1' floodway.
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.		We have to official BFE. We have been attempting to get FEMA to provide this information for over 10 years. We are now having meetings with FEMA to get this information.
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Yes	Floodplain Overlay District Code Section 23-7.2 addresses all of the requirements
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Yes	Through building permits and our CRW tracking system
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Yes	Floodplain Overlay District Code Section 23-7.2 addresses all of the requirements

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	Yes	Floodplain Overlay District Code Section 23-7.2 addresses all of the requirements Chesapeake bay Act code section chapter 6A Stormwater management code section chapter 19A

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	Yes	Through our EMS and GWRC planning district commission.
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	No	With no changes since 1998 we have not had the opportunity. We have the mechanism to do so through public hearings and direct mail notifications
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	Yes	As needed usually updated maps to prove the location of the structure compared to the actual floodplain using new LIDAR system for GIS.

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: STAFFORD COUNTY, VIRGINIA

1. FLOODPLAIN IDENTIFICATION AND MAPPING			
Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	Y	FIRM and FIS are maintained at the Department of Planning and Zoning
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	Y	The most recent FIRM for a portion of the County and FIS were adopted by the County on 2/18/2015
c. Does the municipality support request for map updates?	If yes, state how.	Y	By providing necessary information
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	N	
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	Y	1. Completes Flood Plain determination requests by citizens within 24 hours 2. Coordinates with FEMA on MT forms
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	Y	Hard copies are maintained in a log book of FEMA letters. When there is a Letter of Map Change, the information is incorporated in the floodplain layers on the County GIS

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	Y	
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	Y	Permits are reviewed for compliance with the requirement of SFHA. In case a Letter of Map Change is required, it is obtained prior to permit issuance.
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	Y	County code requires that BFE data be obtained on subdivision proposal larger than 5 acres
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Y	Planning and Zoning and Public Works
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Y	Public Works
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Y	Community Rating System cycle visit confirms that it is complied

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	Y	County participates in the Community Rating System. Chapter 28-57 of the County Code ascertains that storage of chemicals and manufactured homes are not permitted in SFHA.

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	Y	By providing letters to property owners on an annual basis
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	Y	Public meetings
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	N	