Rappahannock-Rapidan
REGIONAL COMMISSION

Rappahannock Rapidan Regional Hazard Mitigation Plan 2018

PLAN SECTIONS

Note: Appendices include Mitigation Strategy Information (New strategies and status reports), Stakeholder Committee Meeting Materials, Local Responses for Capability Assessment, Community Rating System *What-If Scenarios*, and additional public outreach materials

Hazard Mitigation is defined as those actions taken to reduce, or eliminate, the effects of natural hazards on a locality and its population. The purpose of a mitigation plan is to identify risks and vulnerabilities associated with natural disasters, and develop long-term strategies for protecting people and property from future hazardous events.

The Disaster Mitigation Act (DMA), passed in 2000, establishes the legal basis for this plan and for the Federal government's efforts to reduce the cost of disasters in the United States. The DMA require local and state governments to develop and adopt Hazard Mitigation Plans (HMPs) in order to be eligible for federal assistance through the Hazard Mitigation Grant program (HMGP) and the Pre-Disaster Mitigation (PDM) program. Both programs are administered by the Federal Emergency Management Agency (FEMA) under the U.S. Department of Homeland Security.

The first Rappahannock-Rapidan Region Multi-Jurisdictional All Hazard Mitigation Plan was approved by FEMA in 2005 and subsequently adopted by the five member counties – Culpeper, Fauquier, Madison, Orange and Rappahannock – and the towns of Culpeper, Madison, Orange, Remington and Warrenton (see table 1.1.) The plan was then updated in 2012 and again in 2018 and adopted by the aforementioned localities.

In accordance with the DMA, this plan has been updated and prepared in coordination with FEMA Region III and the Virginia Department of Emergency Management. A Local Mitigation Plan Crosswalk, found in Appendix B, provides a summary of federal and state minimum standards and notes where each requirement is met within the Plan.

Table 1.1

JURISDICTION	2004 PARTICIPATION	2011 PARTICIPATION	PLAN ADOPTION DATE	2018 PARTICIPATION
Culpeper County	Yes	Yes	July 3, 2012	Yes
Fauquier County	Yes	Yes	July 12, 2012	Yes
Madison County	Yes	Yes	July 10, 2012	Yes
Orange County	Yes	Yes	July 24, 2012	Yes
Rappahannock County	Yes	Yes	August 6, 2012	Yes
Town of Culpeper	Yes	Yes	July 10, 2012	Yes
Town of Gordonsville	No	No	-	Yes
Town of Madison	Yes	Yes	July 5, 2012	Yes
Town of Orange	Yes	Yes	August 20, 2012	Yes
Town of Remington	Yes	Yes	July 9, 2012	Yes
Town of Warrenton	Yes	Yes	August 14, 2012	Yes
RRRC	Yes	Yes	August 22, 2012	Yes

PURPOSE

As a comprehensive strategy designed to reduce or eliminate the impacts of natural hazards in the region served by the Rappahannock-Rapidan Regional Commission (RRRC), this plan includes specific programs and policies that may be implemented by member localities to assure readiness and resilience in response to disasters. The purpose of this plan is to:

- Protect life and property, as well as natural systems and historic resources, by reducing the potential for damage and economic losses from natural and human-caused hazards;
- Improve community safety;
- Increase public understanding, support and demand for hazard mitigation;
- Speed response, recovery and redevelopment following disaster events;
- Demonstrate a firm commitment to hazard mitigation principles;
- Comply with state and federal requirements for local hazard mitigation planning; and
- Qualify for grant funding in both the pre- and post-disaster environment.

AUTHORITY

The Rappahannock-Rapidan Multi-Jurisdictional All Hazard Mitigation Plan was developed in accordance with all current applicable state and federal regulations. Upon approval by FEMA, the participating counties and towns will adopt the plan via resolution in accordance with the authority granted to counties and towns under §15.2-2223 through §15.2-2231 of the Code of the Commonwealth of Virginia. This plan will be monitored routinely and revised to maintain compliance with federal requirements.

This plan was prepared in accordance with the requirements of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementation regulations set forth by the Interim Final Rule published in the Federal Register on February 26, 2002 (44 CFR §201.6) and finalized on October 31, 2007, referred to collectively hereafter as the Disaster Mitigation Act (DMA). While the Act emphasized the need for mitigation plans along with coordinated mitigation planning and implementation efforts, the regulations established requirements that local hazard mitigation plans must meet in order for local jurisdictions to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288). In addition, the DMA 2000 specifies those criteria required for the preparation and adoption of multi-jurisdictional, all-hazard mitigation plans.

This plan has been developed with input and assistance from the Virginia Department of Emergency Management (VDEM) and is consistent with the requirements outlined by VDEM.

USE OF THIS DOCUMENT

The Rappahannock-Rapidan Hazard Mitigation Plan was been developed to serve the multi-jurisdictional region as a whole rather than individual localities. Each jurisdiction-specific segment has been designed to allow for each locality’s review and acceptance, independent of the material in the remainder of the plan that applies in a regional format.

This plan is organized into the following sections:

1. **Introduction**
2. **Planning Process:** Plan requirements, description of the planning process, plan update participants.
3. **Regional Profile**: Overview of the Rappahannock-Rapidan region, including population, land use,

transportation, housing, employment, and declared disasters.

4. **Hazard Identification:** Identification and description of hazards affecting the region.
5. **Hazard Analysis:** Description of historical hazard occurrences in the region.
6. **Vulnerability Assessment:** Assessment of the potential impacts of the hazards identified in the previous section based on historical occurrences and other evidence of risk.
7. **Capability Assessment:** Assessment of jurisdictions' capability to develop and implement mitigation strategies and identify realistic goals and opportunities for jurisdiction response.
8. **Mitigation Strategy:** Goals, actions, and potential projects to address the identified hazards based on the findings of the Vulnerability and Capability Assessments (local mitigation strategies can be found in appendix A).
9. **Plan Maintenance:** Detailed procedures for implementing the plan, monitoring implementation, and updating the plan in the future.

Section 2: Planning Process

This section describes the planning process undertaken by the Rappahannock-Rapidan Regional Commission and participating jurisdictions in the regional plan update process. Topics include: overview of hazard mitigation planning; planning team participation; explanation of how the Plan was prepared and updated.

HAZARD MITIGATION PLANNING

Hazard mitigation planning is the process of organizing community resources, identifying and assessing hazard risks, and determining how to minimize or manage those risks. While this Plan deals primarily with natural hazards, human-caused hazard risk has also been analyzed and discussed in Appendices E and F. Mitigation planning can be described as the means to break the repetitive cycle of disaster loss. A core assumption of hazard mitigation is that pre-disaster investments will significantly reduce the demand for post-disaster assistance by lessening the need for emergency response, repair, recovery and reconstruction. The primary objective of the planning process is the identification of specific mitigation actions, which when viewed as a whole, represents a comprehensive strategy to reduce the impact of hazards. Responsibility for each mitigation action is assigned to a specific individual, department or agency along with a schedule for its implementation. *Plan Maintenance Procedures* (located in Section 9 of this Plan) are established to monitor progress, including the regular evaluation and enhancement of the Plan. The maintenance procedures ensure that the Plan remains a dynamic and functional document over time.

Mitigation planning offers many benefits, including:

- Saving lives and property;
- Saving money;
- Speeding recovery following disasters;
- Reducing future vulnerability through wise development and post-disaster recovery and reconstruction;
- Expediting the receipt of pre-disaster and post-disaster grant funding; and
- Demonstrating a firm commitment to improving community health and safety.

As referenced in Section 1, DMA 2000 requires state and local governments to develop and formally adopt natural hazard mitigation plans in order to be eligible to apply for Federal assistance under the HMGP. The Act authorizes up to seven percent of HMGP funds available to a State after a disaster to be used for the development of State, tribal, and local mitigation plans.

Adoption of this plan and approval from FEMA is required for localities to remain eligible to apply for the three Hazard Mitigation Assistance (HMA) Programs. These HMA programs present a critical opportunity to reduce the risk to individuals and property from natural hazards while simultaneously reducing the reliance on Federal disaster funds. States, Territories, Indian Tribal governments, and communities are encouraged to take advantage of funding provided by HMA programs in both pre- and post-disaster timeframes.

Together, these programs provide significant opportunities to reduce or eliminate potential losses to State, Tribal, and local assets through hazard mitigation planning and project grant funding. Each HMA program was authorized by separate legislative action, and as such, each program differs slightly in scope and intent. The guidance applies to the programs of: Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Program (PDM), and Flood Mitigation Assistance Program (FMA). While the statutory origins of the programs differ, all share the common goal of reducing the risk of loss of life and property due to natural hazards.

In general, the local government is a “sub-applicant” that is an eligible entity that submits a sub-application for FEMA assistance to the "Applicant" which would be the Commonwealth of Virginia. If HMA funding is awarded, the sub-applicant becomes the “sub-grantee” and is responsible for managing the sub-grant and complying with program requirements and other applicable Federal, State, Territorial, Tribal, and local laws and regulations. By incorporating the three programs together the HMA consolidates the common requirements for all programs and explains the unique elements of the programs in individual sections. The organization improves the clarity and ease of use of the guidance by presenting information common to all programs in general order of the grant life cycle. The HMA Unified Guidance can be found on FEMA's website at http://www.fema.gov.

Flood Mitigation Assistance Program (FMA): To qualify to receive grant funds to implement projects such as acquisition or elevation of flood-prone homes, local jurisdictions must prepare a mitigation plan. The plan must include specific elements and be prepared following the process outlined in the National Flood Insurance Program's (NFIP) Community Rating System.

Hazard Mitigation Grant Program (HMGP): To qualify for post-disaster mitigation funds, local jurisdictions must have adopted a mitigation Plan that is approved by FEMA.

Pre-Disaster Mitigation Grant Program (PDM): To qualify for pre-disaster mitigation funds, local jurisdictions must adopt a mitigation Plan that is approved by FEMA.

In addition to the HMA funding programs, States, localities, and other political subdivisions may utilize other funding programs and sources to implement mitigation projects. Examples of such programs are Community Development Block Grant (CDBG) funds, Emergency Management Performance Grants, Stormwater or Watershed restoration grants, and locally adopted Capital Improvement Programs (CIP).

PLANNING TEAM ORGANIZATION

The Rappahannock-Rapidan Regional Hazard Mitigation Plan included participation by planning staff and emergency management officials from participating counties and towns, staff members from the Rappahannock-Rapidan Regional Commission, and state agency officials. Participants in this and past versions of the hazard mitigation planning process include: local Police, Fire and Rescue Departments, State Police, regional non-profit organizations, community colleges, utility companies and interested members of the public.

Point of contact information for each participating jurisdiction and supporting agency, along with planning team meeting attendance sheets, can be found in the appendix to this plan. In cases where localities were unable to attend planning team meetings, Rappahannock-Rapidan Regional Commission staff met separately with jurisdiction staff to provide project updates and provide assistance with the planning process.

PLAN PREPARATION

The plan contained herein reflects an update completed in 2017 and 2018 by the Rappahannock-Rapidan Regional Commission and those localities participating in the hazard mitigation plan process. This plan is a revision to the previously approved and adopted plans completed in 2005 and revised in 2012. In both previous instances of the plan, FEMA provided approval to the plans prior to adoption by participating localities.

The 2018 version of the RRRC Regional Hazard Mitigation Plan was developed in accordance with the provisions of the Disaster Mitigation Act of 2000(Public Law 106-390), the Pre-Disaster Mitigation Grant Program, 44 Code of Federal Regulations Part 206, and the planning standards adopted by the Virginia department of Emergency Management. It should also be noted that both the original HMP and the updated HMP were prepared in accordance with the process established in the FEMA 386-series of mitigation planning How-To guides, as well as the requirements of the February 26, 2002 IFR and July 1, 2008 Local Multi-Hazard Mitigation Planning Guidance document.

The 386-series of guides provided the structure for the process that was used to develop and update the Regional Mitigation Plan. Each section of this updated Plan includes specific information regarding how the

FEMA Interim Final Rule requirements were met, as well as the process that was used to obtain and interpret data, determine and prioritize goals, strategies and actions, and implement and monitor elements of the Plan.

DEVELOPMENT OF 2018 PLAN UPDATE

The Rappahannock-Rapidan Regional Commission coordinated the updates to the Regional Hazard Mitigation Plan in 2017 and 2018, with assistance from FEMA and the Virginia Department of Emergency Management, including a Pre-Disaster Mitigation Grant (#PDM-2016-002).

The Rappahannock-Rapidan Regional Hazard Mitigation Plan includes five counties and eight incorporated towns. To satisfy multi-jurisdictional participation requirements, counties and local towns were required to perform the following tasks:

- Participation/Attendance at mitigation planning meetings;
- Completion the Local Capability Assessment Survey;
- Identification of any unique local hazards apart from the identified regional hazards;
- Identification of completed mitigation projects, if applicable; and
- Update and develop additional mitigation actions and strategies.

Three planning team meetings were held as part of the process of updating the plan. All meetings were held at the Rappahannock-Rapidan Regional Commission offices and were publicly advertised and open to the public.

- **March 29, 2017: RRRC Regional Hazard Mitigation Plan Update Kickoff Meeting**
    - Regional Hazard Mitigation History
    - State Mitigation Status
    - Proposed Timeline
    - Responsibilities and Data Needs
    - Plan Integration and Coordination
- **August 28, 2017: RRRC Regional Hazard Mitigation Plan Update Meeting**
    - Hazard Identification Review
    - Unique Hazard Identification Review
    - Hazard History Update & Review
- **May 23, 2018: RRRC Regional Hazard Mitigation Plan Update Meeting**
    - Critical Facilities/Asset Inventory Review
    - Demographic Analysis Update & Review
    - Mitigation Action & Strategy Review

During the kickoff meeting, the planning team stakeholders determined that no new hazards would be added to the 2012 plan. However, consensus was reached to combine the Sinkhole and Karst sections into a single hazard, and to combine the Erosion and Landslide hazards into a single hazard. These hazards have minimal data available related to past impacts and future probability, but there was support for keeping them in the plan.

Meetings to review locality-specific unique hazards, mitigation strategies, and capability assessment information were held with each participating jurisdiction during 2018. At minimum, these meetings included RRRC staff and the primary point of contact for each participating jurisdiction.

In addition, RRRC staff coordinated with other regional committees to provide updates and gather information in support of the Hazard Mitigation plan update. These meetings include bi-monthly meetings of the VDEM Region II Culpeper Sub-Area Emergency Managers, the RRRC Land Use & Environment Committee, and the Rappahannock-Rapidan Emergency Preparedness Task Force managed by the Rappahannock-Rapidan Health District.

RRRC staff also coordinated two stand-alone workshops during 2017 that directly facilitated information sharing related to Hazard Mitigation planning. These workshops were:

- **October 11, 2017: Floodplain Management Workshop**
  - Workshop hosted by RRRC in Culpeper
  - Virginia Department of Conservation and Recreation Division of Floodplain Management staff provided training and overview of floodplain management best practices and regulations for local floodplain administrators, planners, engineers, and emergency managers

- **December 15, 2017: Land Cover GIS Data Workshop**
  - Workshop hosted by RRRC in Culpeper
  - Presentations on 1 meter resolution GIS Land Cover data for the region and potential applicability towards GIS modeling and Land Use decisions

Throughout 2017, local and regional staff completed updates to the hazard identification and analysis, vulnerability analysis, capability assessment and mitigation action strategies sections of the plan.

During the plan update process, a publicly accessible survey was made available on the Rappahannock-Rapidan Regional Commission's website (http://www.rrregion.org) for interested members of the public to provide feedback on the plan update and specify local and regional hazards and vulnerabilities. A copy of the survey can be found in the appendix to this plan.

Following coordination reviews with each of the participating jurisdictions, Rappahannock-Rapidan Regional Commission staff developed the draft 2018 RRRC Regional Hazard Mitigation Plan in 2017 and 2018. The draft plan was made available for public review and comment for a three-week period ending on June 29, 2018. Draft copies of the plan were available via the Regional Commission's website and hard copies were made available at the Rappahannock-Rapidan Regional Commission and public libraries in the county seats of the five counties in the region.

Stakeholders, including the neighboring planning district commissions of Thomas Jefferson, Northern Shenandoah, Northern Virginia, and George Washington, along with other local, regional, and state agencies were included in outreach notices delivered via e-mail prior to the plan kickoff, in advance of committee meetings, and at the time of the public review. Copies of these notifications are included in Appendix B.

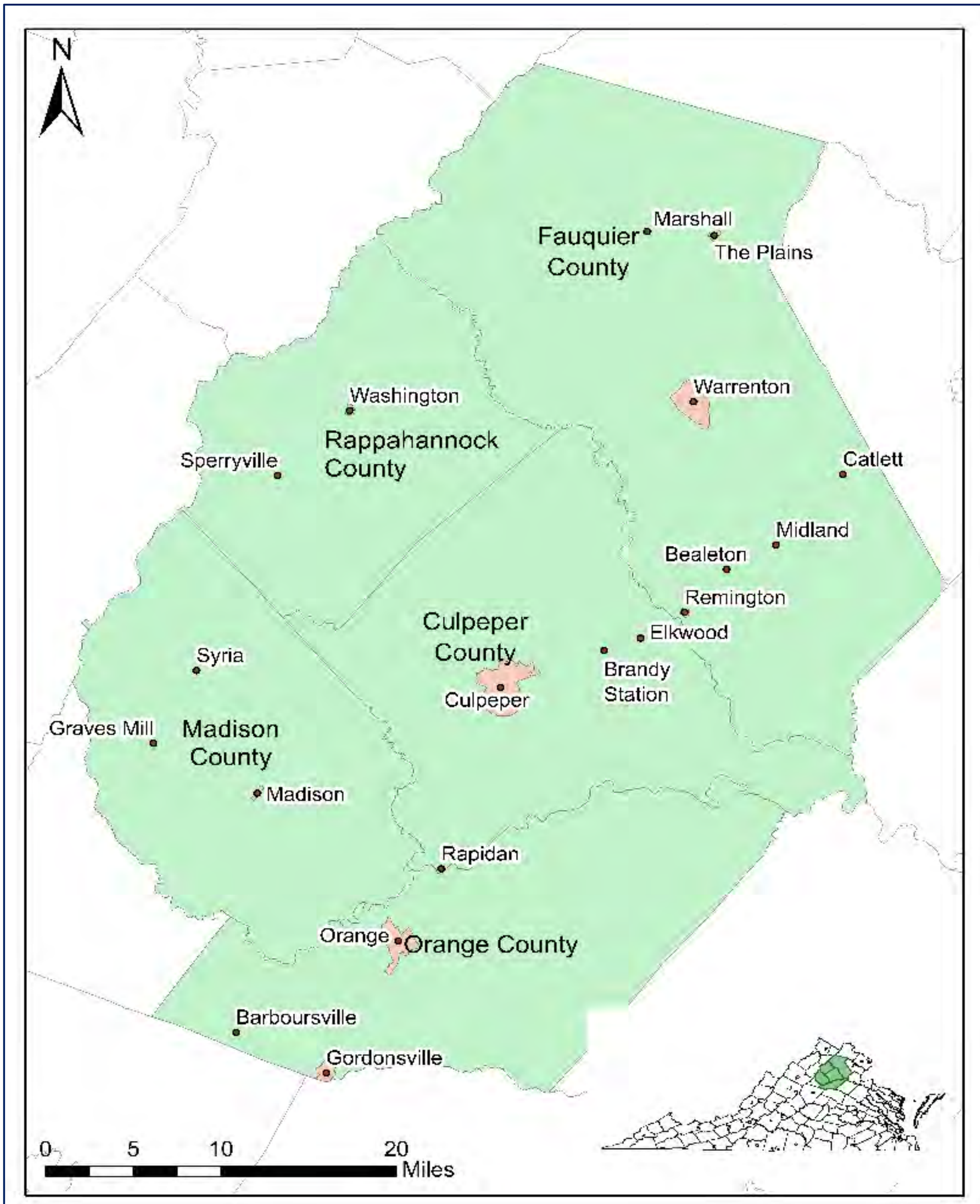
Comments received from Hazard Mitigation stakeholders after the release of the draft plan were incorporated, as applicable, into the draft 2018 Rappahannock-Rapidan Regional Hazard Mitigation Plan prior to submission to FEMA for conditional approval.

PLAN ADOPTION

Following conditional approval from FEMA, each participating jurisdiction held a public hearing prior to adoption of the 2018 Rappahannock-Rapidan Regional Hazard Mitigation Plan update. Each county and town held their regularly scheduled board or council meetings at which time the final version of the plan was presented for adoption. These meetings are publicly advertised by law. The meetings provided citizens a final opportunity to comment and suggest possible revisions.

Made up of the counties of Culpeper, Fauquier, Madison, Orange and Rappahannock, and the incorporated towns of Culpeper, Gordonsville, Madison, Orange, Remington, The Plains, Warrenton, and Washington, the Rappahannock-Rapidan region covers 1,965 square miles (1,257,600 acres) and is home to 175,151 persons. Named for two regionally significant rivers, the area is in north-central Virginia in the foothills of the Blue Ridge Mountains. It is served by the Rappahannock-Rapidan Regional Commission (RRRC), Planning District 9 (PD9), which works within these jurisdictions to encourage and facilitate collaborative solutions to area-wide problems and concerns.

Figure 3.1, Overview of the Rappahannock-Rapidan Region



With the Town of Culpeper as its approximate geographic center, the region is about seventy miles southwest of Washington D.C., eighty-five miles northwest of Richmond, Virginia, and forty-five miles north-east of Charlottesville, Virginia. As part of the Virginia Piedmont, the area is predominantly rural. It is characterized by thickly forested hillsides, gently rolling farmlands and small towns and villages. Residents enjoy a lifestyle focused on small communities, abundant natural resources, and ready access to outdoor recreation. World class museums, outstanding cultural opportunities and all levels of spectator and participant sports events are available nearby.

The relative affordability of the area, has resulted in a significant increase in population over the past 15 years. For the most part, families moving into the region came from Northern Virginia, Washington D.C, Fredericksburg and Charlottesville.

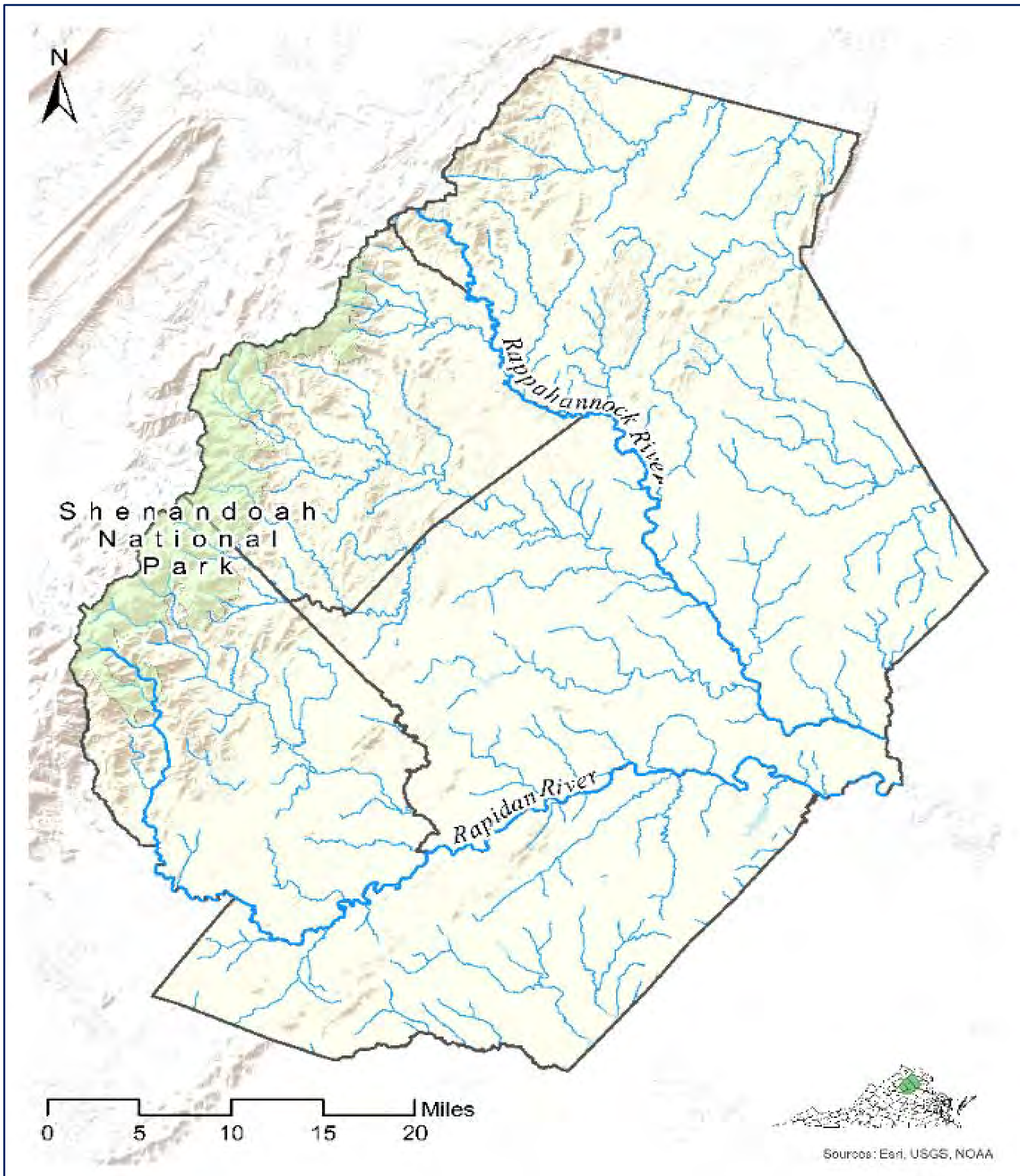
Newcomers' needs for housing and associated development and services increased demands on the region's resources. Residential communities have sprung up along primary commuter corridors, straining the area's transportation network. Although the area's economy is rooted in agriculture, an increasing number of residents travel daily to jobs in the surrounding region, including Northern Virginia, Washington, D.C. and Charlottesville.

COMMUNITY PROFILE

Many of the region's natural hazards reflect its topography and hydrology. From the Blue Ridge Mountains at its western edge, to the rolling farmland of the Piedmont in the east, the region has a varied geology and unique physiographic character. Because of high elevations and steep slopes, Madison and Rappahannock Counties are prone to flash-floods, sometimes accompanied by landslides. Dense forests in these areas add the possibility of forest fires. Overall, flooding is the most common natural hazard that impacts the region. Rainstorms of historic significance occasionally have produced severe localized flooding. The entire region routinely experiences ice storms, significant snowfall, high winds, forest fires, and the effects of tropical storms and hurricanes.

GEOGRAPHY

Figure 3.2, Geography of the Rappahannock-Rapidan Region

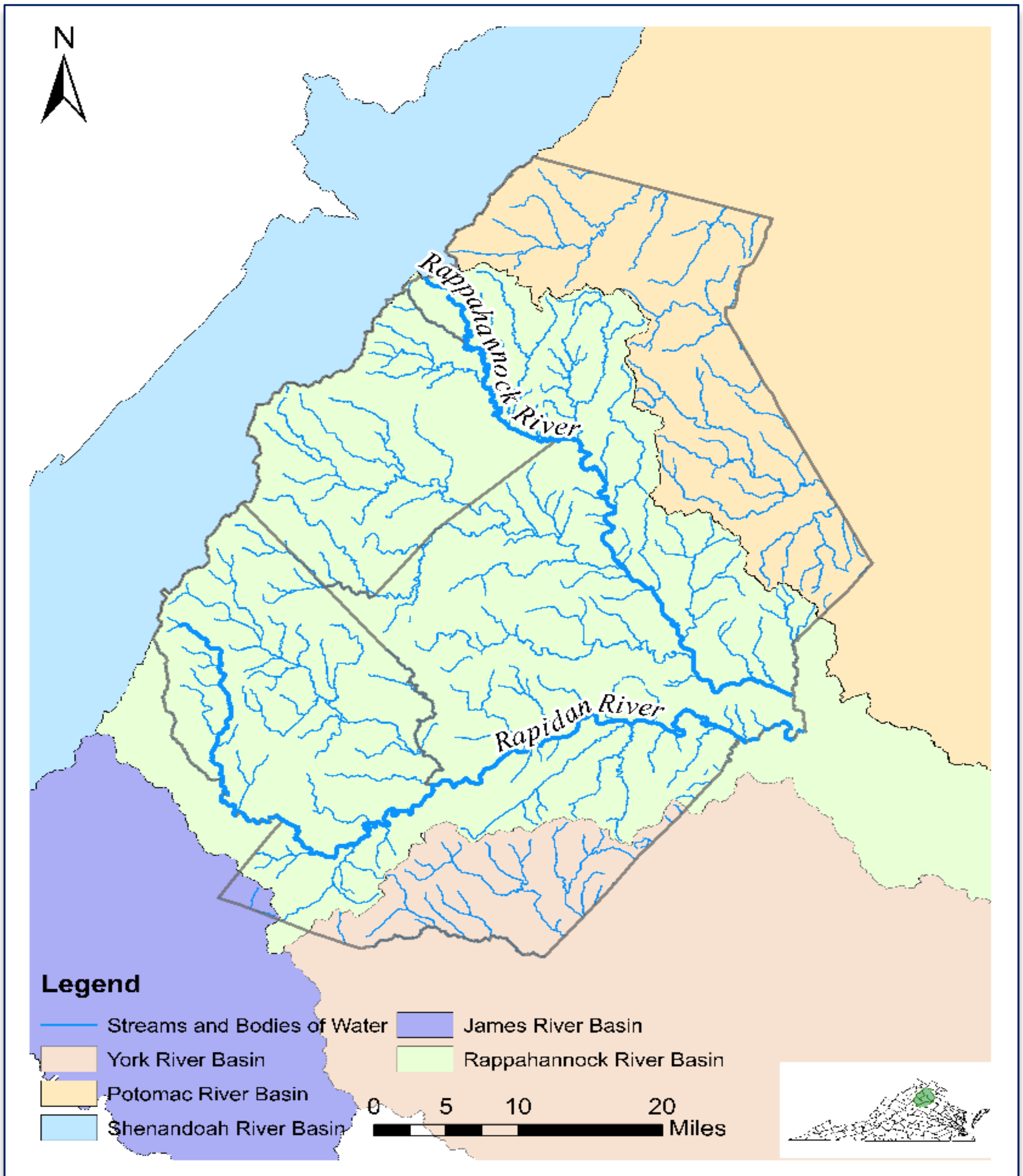


The counties of the Rappahannock-Rapidan region cover approximately 1,965 square miles. Fauquier County, at 660 square miles, is the largest and almost twice the size of the next largest county, Culpeper, at 389 square miles. With steep, heavily forested slopes, and peaks in excess of 3,000 feet, the Blue Ridge Mountains mark the western edge of the region. Many of the larger federal and state owned properties in the region are located here, including Shenandoah National Park, a section of the Appalachian Trail, Sky Meadow State Park, and the Rapidan and Thompson wildlife management areas. The Thompson, Weston and Chester Phelps wildlife management areas, as well as the Whitney State

Forest, are in the eastern part of the region where the landscape reflects the character of the Virginia Piedmont - rolling farm fields and forests, punctuated by small towns.

The Rappahannock River traverses the region from northwest to southeast. Over 184 miles in length from its headwaters in Shenandoah National Park to its mouth at the Chesapeake Bay, the Rappahannock, along with its tributaries, the Hazel, Hughes, Rush, Thornton, Robinson and Rapidan rivers, drains the greater part of the region. About sixty percent of its watershed is forested, with another seventeen percent devoted to agricultural uses. Lesser portions of the region drain south to the York River and north to the Potomac.

Figure 3.3, Major River Basins



Global scale weather patterns modified by the region's diverse landscape result in variable climate and weather experiences throughout the five-county area. Storms and systems tracking from west to east interacting with more tropical coastal air masses produce a variety of outcomes and conditions. The mass of the Blue Ridge Mountains directs, blocks and modifies the impacts of storms and systems while the relative proximity of the Atlantic Ocean influences temperature and humidity. Overall, the climate is moderate with an average annual temperature of about 56 degrees. Summer temperatures tend to be in the 70s, while winter temperatures are typically in the 30s. The average annual rainfall is about 42", with snowfall throughout the region averaging about 20" per year.

POPULATION

From 2000 to 2010, the population of the region grew by 23.2%, with most newcomers from Washington D.C. and the Northern Virginia metropolitan area. Population growth in the region has slowed since the 2011 Hazard Mitigation Plan update, yet all but Madison County have continued to experience increases (see Table 3.1). From 2010 to 2016, the population of the region increased by 5% to 175,151 people. Both Culpeper and Fauquier counties experienced population increases of over 10,000 from 2000 to 2010, while Orange County grew by over 7,500. Fauquier County overwhelmingly remains the most populous county in the region (Table 3.1). Culpeper and Orange counties' growth rates of 36.3 percent and 29.4 percent respectively, are more than double the average growth rate for the Commonwealth.

Table 3.1, Rappahannock-Rapidan Region Population: 2000-2017

Locality	Population			Population Change	
Towns	**2000**	**2010**	**2017**	**% Change 2010-2017**	**% Change 2000-2017**
Culpeper	9,664	16,379	18,413	12.4%	90.5%
Gordonsville	1,498	1,496	1,591	6.4%	6.2%
Madison	210	229	242	5.7%	15.2%
Orange	4,123	4,721	4,978	5.4%	20.7%
Remington	624	598	639	6.9%	2.4%
The Plains	266	217	231	6.5%	-13.2%
Warrenton	6,670	9,611	9,875	2.7%	48.1%
Counties	**2000**	**2010**	**2017**	**% Change 2010-2017**	**% Change 2000-2017**
Culpeper	34,262	46,689	51,282	9.8%	49.7%
Fauquier	55,139	65,203	69,465	6.5%	26.0%
Madison	12,520	13,308	13,277	-0.2%	6.0%
Orange	25,881	33,481	36,073	7.7%	39.4%
Rappahannock	6,983	7,373	7,321	-0.7%	4.8%
R-R Region	**134,785**	**166,054**	**177,418**	**6.8%**	**31.6%**
Virginia	**7,079,048**	**8,001,024**	**8,470,020**	**5.9%**	**19.6%**
USA	**281,424,602**	**308,745,538**	**325,719,178**	**5.5%**	**15.7%**

Source: *U.S. Census Bureau *County populations include incorporated town populations.*

Table 3.2, County Population Densities

County	Land Area (square mi.)	2017 Population (U.S. Census)	Persons per square mile (2010)	Persons per square mile (2017)
Culpeper	379	51,282	123	135
Fauquier	648	69,465	101	107
Madison	321	13,277	41	41
Orange	341	36,073	98	106
Rappahannock	266	7,321	28	28
R-RRC Region	**1955**	**177,418**	**85**	**91**

Source: *2017 U.S. Census Bureau-Tigerline File Calculation from ALAND*

Despite increases in population, the region's population density remains rather low at 90 individuals per square mile, considerably less than that of Virginia at 213 persons per square mile, although only slightly less than the national average of 91 persons per square mile (Table 3.2). Due to its size and proximity to the highly urbanized Northern Virginia area and Washington D.C., approximately 40% of the region's residents live in Fauquier County. On the opposite end of the spectrum, Rappahannock County contains 4 percent of the region's population.

According to population projections released in June 2017 by the Weldon Cooper Center for Public Service, the region's population is projected to increase by 13 percent between 2020 and 2030 (see Table 3.3). Much of the projected growth is contained within Culpeper, Fauquier, and Orange counties, matching recent trends and historical patterns of growth in the region.

Table 3.3, County Population Projections

County	2017 Population (U.S. Census)	2020	2030	2040
Culpeper	51,282	50,912	60,253	68,572
Fauquier	69,465	70,302	78,259	84,973
Madison	13,277	12,889	13,182	13,288
Orange	36,073	34,442	39,587	44,080
Rappahannock	7,321	7,236	7,401	7,460
R-RRC Region	**177,418**	**175,781**	**198,682**	**218,373**

Source: *Weldon Cooper Center for Public Service 2017*

Overall, increases in population generally result in more potential impacts from natural hazards. It should be noted, however, that improved construction standards, new building practices and enhanced response programs often offset perceived vulnerabilities. Rapid growth in some of the region's counties requires consideration for the possible increase in potentially vulnerable groups including older residents, those with special needs, individuals living on low or fixed incomes and individuals with no, or limited, access to transportation.

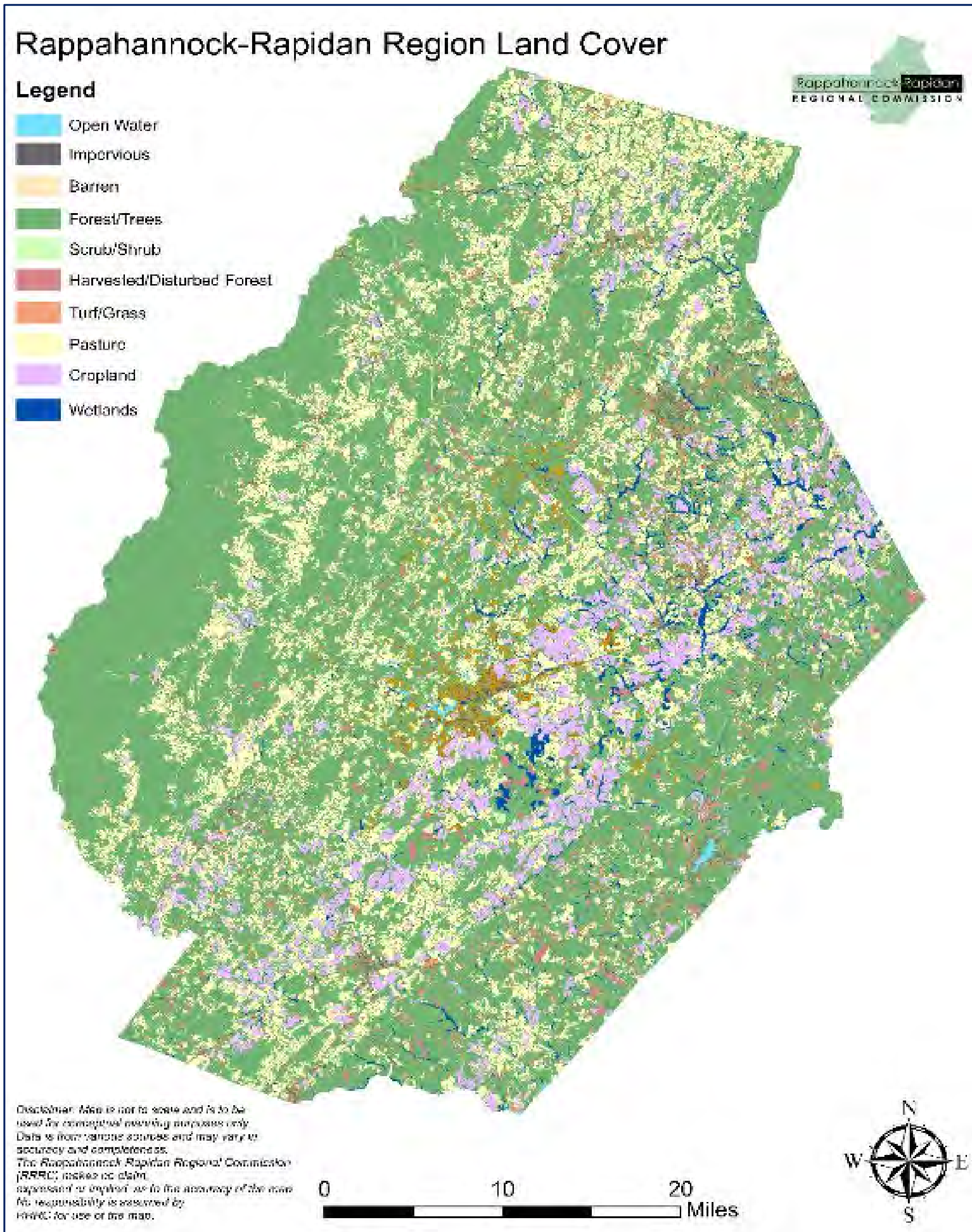
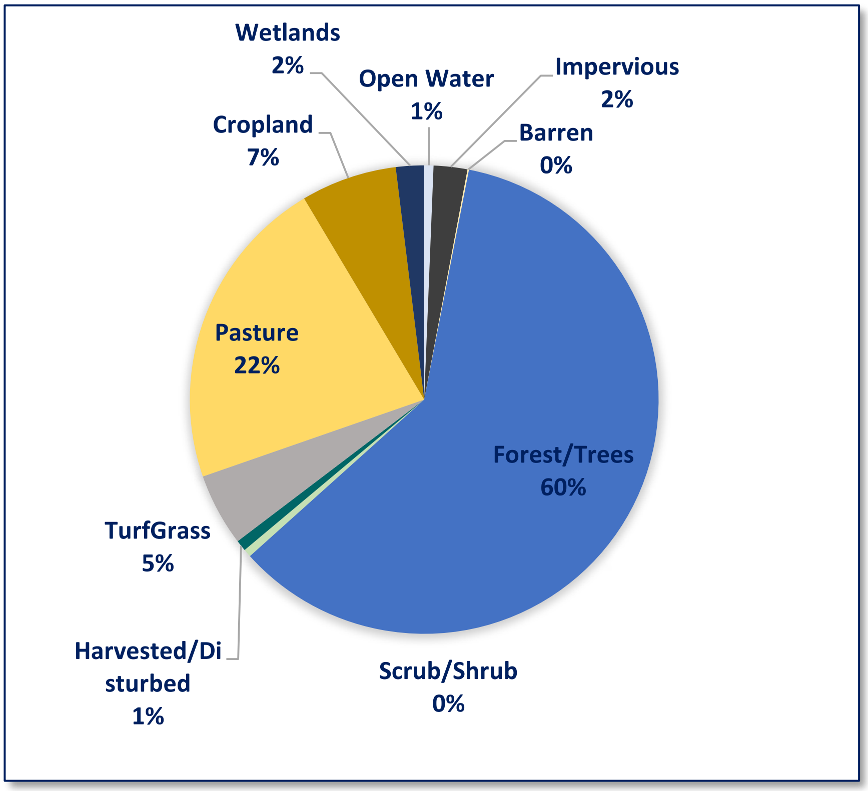


Figure 3.4, Rappahannock-Rapidan Region Land Cover

LAND USE

Despite an increase in residential development, much of the land cover in the region remains forested or agricultural. Impervious surface area is an indicator of urban disturbance of the natural environment. Only 2.3 percent of land within the region is covered by impervious surfaces. Increases in impervious surface area can be associated with increased traffic, air and water pollution. An increase in impervious surface area are also associated with increases in flood severity and frequency due to higher volumes of surface runoff. Impervious surface should be managed within a storm-water management model to protect water quality and mitigate flooding hazards.

Figure 3.5, Rappahannock-Rapidan Region Land Cover Percentages



Approximately 88.7 percent of land in the region is covered by forest, trees, pasture and cropland. The region is predominately agricultural and contains large tracts of undisturbed forest highlighted the by the Shenandoah National Park within the Western portion of Rappahannock and Madison Counties. Large extended areas of forest may be susceptible to wild-fires.

There is little variance between the major land cover types for the five counties within the Rappahannock-Rapidan Region. Forest and tree cover is the dominate land cover for each of the five counties. The second largest land cover type is unanimously pastoral land. Fauquier and Culpeper counties contain most of the cropland and wetlands found within the region. Barren land, described as areas with little or no vegetation characterized by bedrock, desert pavement, and other sand/rock/clay accumulations make up the smallest proportion of land cover within the region. Each of the five counties have relatively low proportions of impervious surfaces. VGIN's Land cover data was developed to support implementation of the Virginia Stormwater Management Act and Chesapeake Bay Watershed Agreement. The data contains 900 times more information than previous National Land Cover Datasets and provides a more accurate representation of land cover classifications than the NLCD. The overall percent change of land cover types from data collection to plan adoption is expected to be minimal due to limited and concentrated development patterns over that time..

Table 3.4, Land Cover by County (Sq.Miles)

Land Cover Type	Culpeper	Fauquier	Madison	Orange	Rappahannock	Rappahannock-Rapidan Region
Open Water	3.4	4.2	1.1	2.7	1.2	12.6
Impervious	11.1	17.2	5.1	8.7	3.7	45.8
Barren	0.9	.7	0.0009	0.3	0.007	1.9
Forest/Trees	202.9	353.4	222.3	209.9	196.8	1185.3
Scrub/Shrub	3.2	4.7	0.8	1.1	0.9	10.7
Harvested/Disturbed	6.3	2.4	0.7	5.1	0.5	15.0
Turf Grass	22.2	42.9	8.2	17.6	7.6	98.5
Pasture	81.0	158.2	65.5	69.5	53.6	427.8
Cropland	40.4	46.6	17.3	23.4	2.4	130.1
Wetlands	11.2	20.8	.9	5.0	.04	37.94
Total	**383**	**651**	**322**	**343**	**267**	**1,965**

Source: *VGIN Land Cover Dataset- based upon the VBMP 2011-2014 band orthophotography.* VITA Land Cover Ref.

TRANSPORTATION

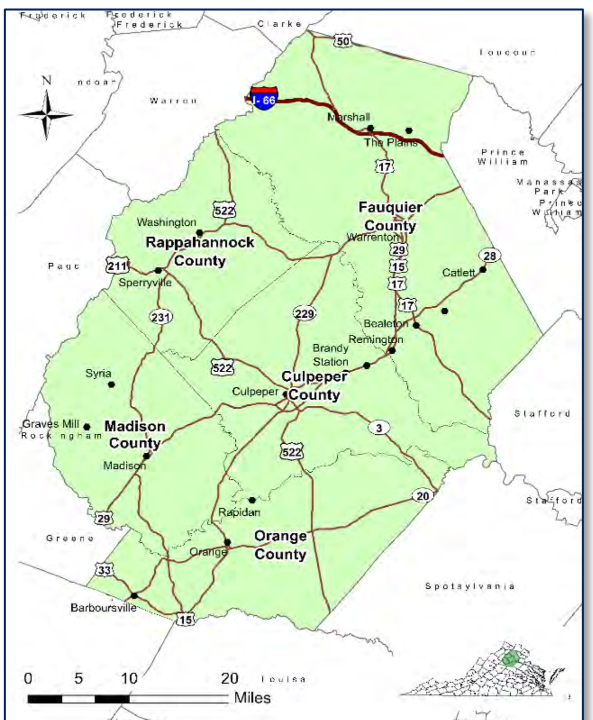
The Rappahannock-Rapidan region is connected by a strong multi-modal transportation network. U.S. Routes 29 and 15 run north - south through the region, providing a connection with the Northeast Corridor cities of Washington, D.C., Philadelphia, New York and Boston. Interstate 66 and U.S. Routes 17 and 522 connect the region east-west. The major eastern U.S. interstates, I-81 and I-95, are each about 30 miles from the heart of the Rappahannock-Rapidan region. I-81, to the west of the region, runs north-south through the Shenandoah Valley. Thirty miles to the east, I-95, the most heavily travelled interstate in the nation, runs north –south connecting all major eastern cities. Both I-66 and I-95 are used heavily by through-travelers, transport companies and those commuting daily to employment in Northern Virginia and the Washington, D.C. metropolitan area.

Table 3.5, Primary and Secondary Roadway Miles by County (2016)

Locality	Primary Miles	% of Region	Secondary Miles	% of Region	Frontage Roads Miles	Total Miles
Culpeper	75.10	19.6	493.51	22.5	2.60	571
Fauquier	105.22	27.4	815.41	37.2	12.73	933
Madison	62.66	16.3	308.34	14.0	.51	372
Orange	82.97	21.6	356.69	16.3	0.00	440
Rappahannock	57.47	15.0	219.39	10.0	.35	277
Total	**383.43**	**100**	**2,193.34**	**100**	**16.19**	**2,593**

Source: *VDOT 2016 Mileage Tables State Highway Systems, VDOT Ref.*

Figure 3.6, Major Transportation Routes

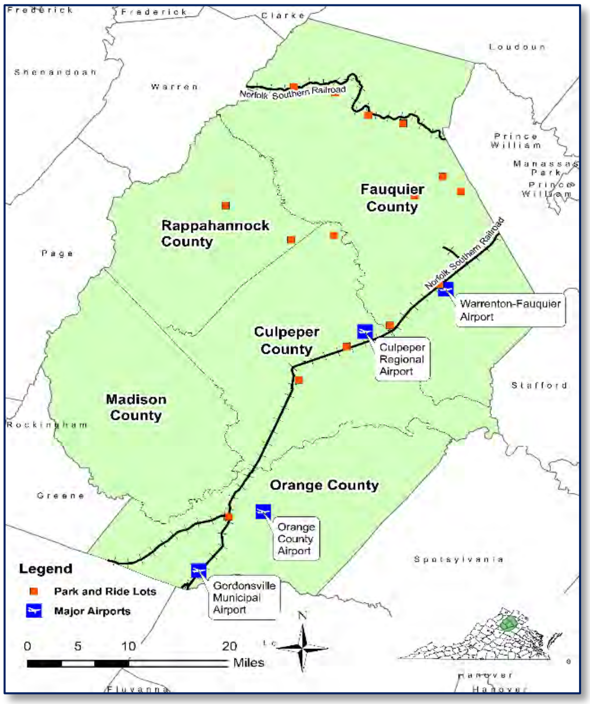


There are over 2,500 miles of primary and secondary roads in the region maintained by the Virginia Department of Transportation (see Table 3.5). Because of its size, population and proximity to the ever-urbanizing Northern Virginia area, Fauquier County has the highest number of miles of primary and secondary roads. Culpeper is second. Many rural areas are served by private roads maintained by homeowners' associations or individuals. Construction standards and maintenance practices on private roads are variable.

Over the last two decades, the Rappahannock-Rapidan region has experienced significant growth, most of which has occurred along the region's principal travel corridors (Fig. 3.6). These highways, commonly used for commuting and through-traffic, have been identified as primary evacuation routes for use in the event of a natural or man-made disaster. As might be expected, current levels of rush hour congestion suggest the potential for extreme gridlock under evacuation circumstances.

Norfolk Southern and CSX Railroad own and operate freight service rail lines that connect the Southeastern U.S. and central Virginia with Washington, D.C. and the Northeast Corridor. With a daily train from Lynchburg, Virginia to Washington, D.C., Amtrak runs the Cardinal and Crescent routes through the region, providing a stop in Culpeper (see Figure 3.7). Plans for expanding

Figure 3.7, Alternative Transportation Routes



commuter rail options include extending VRE service from Manassas to Marshall in northern Fauquier County. In addition, there has been consideration of establishing regular commuter rail service along the Norfolk Southern/ Amtrak line that runs north-south through the region.

Four publicly owned airports provide general aviation services to the region. Culpeper Regional Airport (KCJR) averages 198 aircraft operations per day and Warrenton-Fauquier Airport (KHWY) averages 130 aircraft operations per day. Orange County Airport (KOMH) and Gordonsville Municipal Airport average fewer than 30 aircraft operations per day.
*(**Source**: www.airnave.com)*

HOUSING

Similar to the decrease in the population growth rate previously noted in this chapter, the region's housing growth rate slowed after spiking in the middle of the past decade. Due to its size and proximity to Northern Virginia and the I-66 and Route 29 commuting corridors, Fauquier County has the greatest number of housing units in the region (see Table 3.6). Over the past sixteen years, however, Culpeper and Orange counties have claimed the greatest rate of population growth along with a corresponding growth in the number of housing units.

Table 3.6, Number of Housing Units

County	2000 (U.S. Census)	2010 (U.S. Census)	2017 (Census Estimates)	% Change 2010-2017	% Change 2000-2017	Housing Unit Density (sq. mile)
Culpeper	12,871	17,657	18,656	5.66	44.95	49
Fauquier	21,046	25,600	26,832	4.81	27.49	41
Madison	5,239	5,932	6,070	2.33	15.86	19
Orange	11,354	14,616	15,100	3.31	32.99	44
Rappahannock	3,303	3,839	3,975	3.54	20.35	15
R-RRC Region	**53,813**	**67,644**	**70,633**	**4.42**	**31.26**	**36**

Source: *U.S. Census Bureau*

The steep decline in the number of residential building permits issued (see Table 3.7) and the definite drop in the average sales prices of existing homes (see Table 3.8) further emphasize the regional repercussions of the world-wide recession. Since 2010, this trend has turned around, although the numbers of residential building permits and home prices have not yet returned to pre-recession levels.

Table 3.7, Residential Building Permits

County	2000	2005	2010	2017
Culpeper County	334	1,198	90	329
Fauquier County	533	706	151	380
Madison County	106	123	27	49
Orange County	247	718	54	167
Rappahannock County	44	60	21	28
R-RRC Region	**1,264**	**2,805**	**343**	**953**

Source: *Weldon & Cooper Center*

Table 3.8, Average Residential Real Estate Selling Price

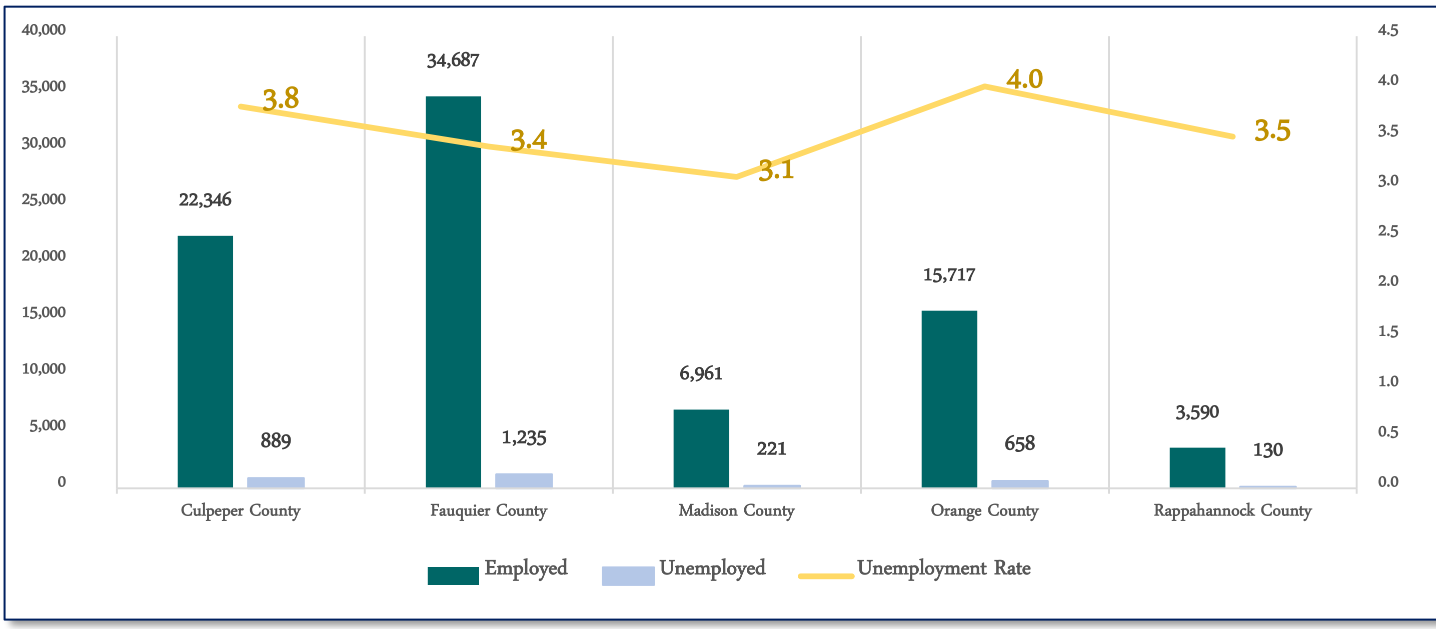
County	2007	2009	2011	2013	2015
Culpeper	$328,922	$196,883	$195,082	$237,839	$269,680
Fauquier	$483,563	$325,372	$330,574	$366,697	$417,109
Madison	$297,072	$217,622	$282,050	$245,081	$270,822
Orange	$319,823	$203,224	$198,475	$208,663	$226,169
Rappahannock	$401,297	$359,122	$359,261	$413,518	$380,879
R-RRC Region	**$419,060**	**$253,666**	**$260,449**	**$294,532**	**$325,731**

Source: *MRIS*

EMPLOYMENT & INCOME

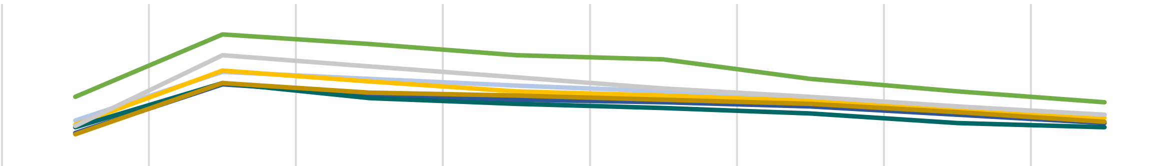
According to the Virginia Employment Commission an estimated 86,068 workers are employed out of an estimated 89,266 available labor force (Figure 3.8). Because of its proximity to Washington, D.C., the Rappahannock-Rapidan Region weathered the recession better than most areas. Unemployment levels in the region tend to be lower than those in other parts of the state and the nation (Figure 3.9). Within the region, unemployment historically tends to be higher in the towns than in the counties.

Figure 3.8, Labor Force Employment & Unemployment, Unemployment Rates by County (2016)



Source: *Bureau of Labor Statistics*

Figure 3.9, Unemployment Rates (2010-2016)



	2005	2010	2011	2012	2013	2014	2015	2016
United States	5.30%	9.80%	9.10%	8.30%	8.00%	6.60%	5.70%	4.90%
Virginia	3.60%	7.10%	6.60%	6.10%	5.70%	5.20%	4.50%	4.00%
Culpeper	3.30%	7.20%	6.40%	5.70%	5.40%	5.00%	4.40%	3.80%
Fauquier	2.70%	6.20%	5.50%	5.10%	4.90%	4.60%	4.00%	3.40%
Madison	3.10%	6.30%	5.20%	4.80%	4.50%	4.10%	3.40%	3.10%
Orange	3.20%	8.30%	7.50%	6.70%	5.90%	5.30%	4.60%	4.00%
Rappahannock	2.60%	6.30%	5.60%	5.40%	5.10%	4.80%	4.20%	3.50%

**The 2005 column demonstrates the 'economic crisis' and in turn shoes the 'economic recovery' in 2010.*
***Source:** Virginia Employment Commission, and U.S. Bureau of Labor Statistics*

The median household income grew in Virginia from 2010-2015 by 5.88% (see Table 3.9). Between 2010 and 2015, median household income increased in Culpeper, Fauquier and Orange Counties, but decreased in Madison and Rappahannock Counties. The greatest increase was in Orange County at 18.66 percent and the sharpest decline was in Madison County at -15.67 percent. The highest median household incomes can be found in Fauquier County at $91,609, which is significantly higher than the income in any of the other counties in the region.

Table 3.9, Median Household Income (2010-2015)

Locality	2010	2015	Percent change
Culpeper County	65,132	66,697	2.40%
Fauquier County	83,877	91,609	9.22%
Madison County	56,608	47,736	-15.67%
Orange County	54,916	65,166	18.66%
Rappahannock County	62,117	57,210	-7.90%
Virginia	**61,406**	**65,015**	**5.88%**

***Source:** U.S. Census Bureau American Community Survey 2015*

DECLARED DISASTERS

Table 3.10, Federally Declared Disasters for the Rappahannock-Rapidan Region (1972-2018)

Locality Affected	Date of Event	Description
Entire Region	09/08/1972	Tropical Storm Agnes
Culpeper	10/10/1972	Severe Storms and Flooding
Orange	10/10/1972	Severe Storms and Flooding
Madison	10/10/1972	Severe Storms and Flooding
Madison	11/10/1985	Severe Storms and Flooding

Rappahannock	05/19/1992	Severe Storms and Flooding
Entire Region	04/11/1994	Severe Winter Ice Storm
Culpeper	07/03/1995	Severe Storms and Flooding
Orange	07/06/1995	Severe Storms and Flooding
Rappahannock	07/06/1995	Severe Storms and Flooding
Madison	07/01/1995	Severe Storms and Flooding
Entire Region	02/02/1996	Blizzard of 96 (Severe Snow Storm)
Fauquier	02/09/1996	Flooding, High Winds and Wind Driven Rain
Rappahannock	02/02/1996	Flooding, High Winds and Wind Driven Rain
Entire Region	09/16/1996	Hurricane Fran, Associated Severe Storm Conditions
Entire Region	02/28/2000	Severe Winter Storms
Fauquier	03/27/2003	Severe Winter Storm, Record/Near Record Snowfall, Heavy Rain, Flooding, and Mudslide
Orange	03/27/2003	Severe Winter Storm, Record/Near Record Snowfall, Heavy Rain, Flooding, and Mudslide
Rappahannock	03/27/2003	Severe Winter Storm, Record/Near Record Snowfall, Heavy Rain, Flooding, and Mudslide
Entire Region	09/18/2003	Hurricane Isabel
Entire Region	09/12/2005	Hurricane Katrina Evacuation Location
Entire Region	12/18/2009	Severe Snowstorm
Entire Region	02/5/2010	Severe Winter Storm and Snowstorm
Entire Region	02/11/2010	Severe Winter Storms and Snowstorms
Culpeper	08/23/2011	Earthquake
Orange	08/23/2011	Earthquake
Entire Region	06/29/2012	Severe Storms and Straight-line Winds
Entire Region	10/26/2012	Hurricane Sandy
Entire Region	01/22/2016	Severe Winter Storm and Snowstorm

Source: *FEMA*

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Some hazards are interrelated while others are made up of elements that are not considered separately. For example, flooding and tornados are often associated with hurricanes, and severe thunderstorms can include damaging lightening. In addition, terrorist-related incidents or accidents involving chemical, radiological or biological agents can coincide with natural hazard events such as flooding resulting from the destruction of a dam or an accidental chemical release caused by a tornado.

Natural hazards identified in this plan:

- Flood
- Severe Thunderstorms & Tornados
- Earthquakes
- Drought/Extreme Heat
- Hurricanes & Tropical Storms
- Dam Failure
- Wildfire
- Winter Storms
- Landslides/Erosion
- Land Subsidence (Karst and/or Sinkholes)

FLOOD

Flooding is the most frequent and costly natural hazard in the United States. Nationally, about 150 people are killed in floods each year. Nearly ninety percent of presidential disaster declarations result from natural events in which flooding is a major component. Historically, Virginia's most significant floods have been associated with hurricanes and tropical storms.

While floods are typically long-term evens that may last for several days, this is not always the case. Usually the result of excessive precipitation, floods may be classified as general floods, characterized by prolonged precipitation over a specific watershed, or flash floods, the product of heavy, localized precipitation of short duration. For the most part, the severity of a flooding event is determined by a combination of overall weather patterns, topography, the type and duration of the precipitation event, existing soil moisture and the extent and type of vegetative cover.

Types of floods include river, flash, coastal and urban, with the first two being Virginia's most significant and most likely to occur within the Rappahannock-Rapidan region. River flooding results from excessive precipitation and high runoff volumes over a large area. In Virginia, river flooding often begins with widespread flash flooding of small streams. This may result from a series of small storms or the impact of larger systems including tropical storms, hurricanes, and northeasters. Snowmelt may also contribute to excessive runoff.

Flash floods, as the name suggests, strike quickly. Resulting from intense rainfall rates that quickly exceed surface absorption capacity, flash floods are often associated with slow-moving thunderstorms, hurricanes and tropical storms. Streams, creeks and drainage-ways quickly become raging torrents. Occurring more frequently along mountain streams,

Swollen Rapidan River near Rapidan, Virginia pictured above. Source: RRRC

flash floods also affect highly urbanized areas where impervious surfaces offer no opportunity for infiltration. Rapidly moving walls of water and associated debris can uproot trees, roll boulders, destroy buildings, and obliterate bridges and roads. Flash floods also may result from the sudden release of water blocked by a shifting ice jam or the spontaneous failure of a dam or levee.

Coastal floods are usually caused by storm surges, wind-driven waves, and heavy rainfall associated with hurricanes, tropical storms, northeasters, and other large coastal storms. Flooding in urban areas occurs when heavy rains or melt-water intercept wide expanses of pavement where reduced permeability, alteration of natural flow regimes, and inadequate, or clogged, storm drains combine to create excessive runoff.

The periodic inundation of floodplains is natural, inevitable and anticipated. Floodplains are designated by the frequency of the event that covers them. This is generally expressed as the statistical probability of flooding in a given year. For example, in any year, the 100-year flood has a 1 percent chance of occurrence.

Unadjusted damage amounts in thousands of dollars are adjusted for inflation. The Construction Cost Index is used to adjust for inflation. The adjustment factor was applied to the unadjusted estimates to get the column damages estimates "adjusted" to 2014 dollars. The Construction Cost Index was obtained from McGraw Hill Construction Engineering News-Record.

Table 4.1 National Flood Losses by Year (Water Year Oct-Sept)

Year	Damages	Flood Fatalities	*Year*	Damages	Flood Fatalities
1991	$3,391,133,218	61	*2003*	$3,636,203,672	86
1992	$1,500,430,125	62	*2004*	$19,254,554,417	82
1993	$30,810,809,608	103	***2005***	**$55,325,587,646**	**43**
1994	$2,031,388,693	91	*2006*	$4,737,440,410	76
1995	$9,160,444,009	80	*2007*	$2,936,200,387	87
1996	$10,681,707,207	131	*2008*	$6,747,571,742	82
1997	$14,694,536,739	118	*2009*	$1,099,446,636	56
1998	$4,136,011,784	136	*2010*	$5,615,860,859	103
1999	$8,828,900,640	68	*2011*	$9,102,294,087	113
2000	$2,110,213,054	38	*2012*	$522,119,985	29
2001	$11,299,869,817	48	*2013*	$2,210,809,876	80
2002	$1,816,823,223	49	*2014*	$2,861,426,089	38
1991-2014	**$214,511,783,923**	**1,860**	**Damages are adjusted per 2014 inflation.*		

Source: *National Oceanic and Atmospheric Administration, Hydrologic Information Center- Flood Loss Data*

HURRICANES & COSTAL STORMS

Hurricanes, tropical storms, and typhoons are all cyclonic storms. In the northern hemisphere, these are characterized by counterclockwise rotational air movement around and into a low-pressure center. Cyclonic storms are Virginia's weather makers. Tropical cyclones, as the name suggests, form over tropical waters and carry with them the heat and moisture typical of those regions. Damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornados. In addition, flooding frequently results from the heavy rainfall that typically accompanies these storms. The key energy source for a tropical cyclone is the release of latent heat from the condensation of moisture-laden air. Most hurricanes and tropical storms form in the Atlantic

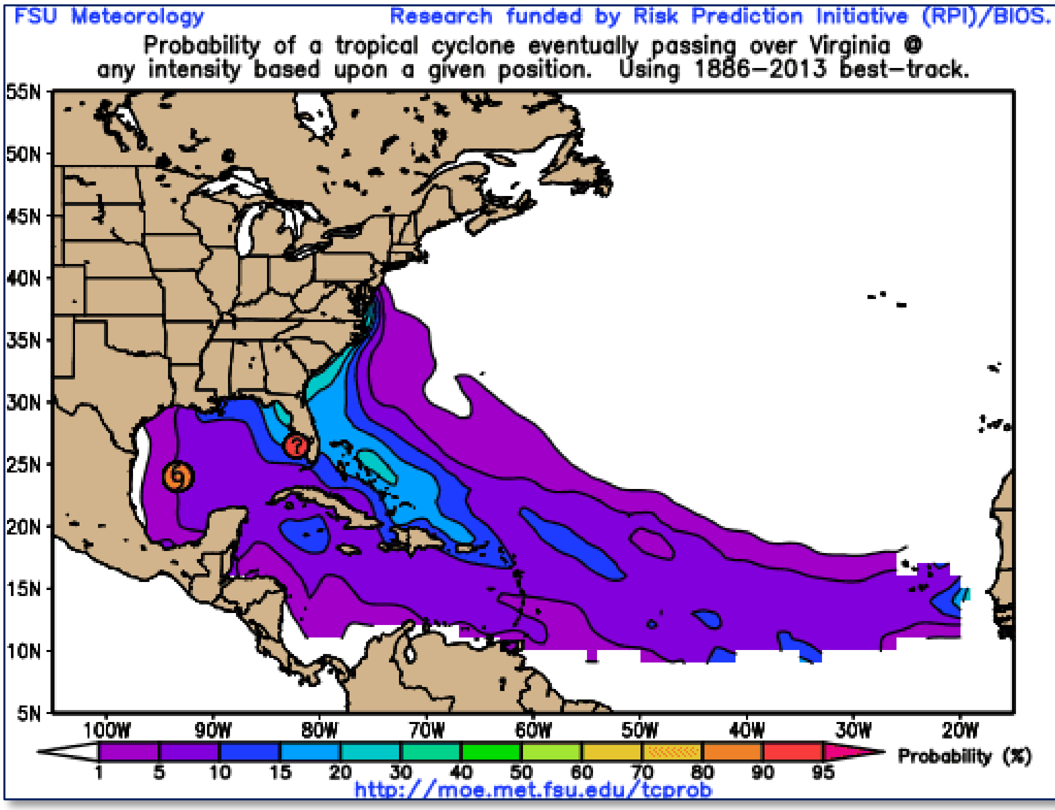
Workers clean up Main Street in the Town of Orange, VA after Hurricane Isabel, September 2003. Photo by Kevin Lamb, The Orange County Review.

Ocean, Caribbean Sea, and Gulf of Mexico during the Atlantic hurricane season, June through November. The peak of the Atlantic hurricane season is early to mid-September. On average, about six storms per year reach hurricane intensity in this region. As recorded, about 69 tropical cyclones have tracked directly across Virginia. Virginia averages about one storm per year. While some years are storm-free, others may witness multiple storms just days or weeks apart.

Figure 4.1 Probability of a Named Storm

This map integrates data from 1886-2013 to indicate the probability of a tropical storm occurring during the June to November Atlantic hurricane season

As a hurricane develops the barometric pressure at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, the storm can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and monitored closely by the National Hurricane Center in Miami, Florida. Once sustained winds reach or exceed 74 miles per hour, the storm is a hurricane.



The Saffir-Simpson Scale categorizes hurricane intensity based on maximum sustained winds, barometric pressure, and storm surge potential, which are combined to estimate potential damage. Categories 3, 4, and 5 are “major” hurricanes. While hurricanes within this range represent only 20 percent of the storms that make landfall, they account for over 70 percent of the damage. Damage typically associated with each hurricane category is summarized below.

Table 4.2 Saffir-Simpson Hurricane Wind Scale

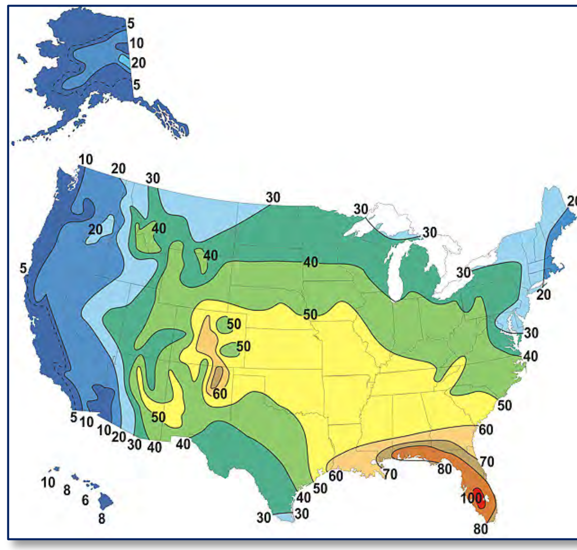
Scale Number Category	**Central Pressure** mb, inches	**Wind Speeds** mi/hr, knots	**Observed Damage**
1	>=980 >=28.94	74-95 64-82	Dangerous winds: Damage to unanchored mobile homes, building roof tops, commercial signage, trees, shrubs, power lines. (Gaston – 2004- Atlantic Coast)

2	965-979 28.50-28.91	96-110 83-95	Extremely dangerous winds: Extensive damage to mobile homes, major roof and siding damage to all structures, trees uprooted, power lines downed, collapse of unreinforced masonry walls.(Isabel – 2003 – Atlantic Coast; Dolly - 2008 - Gulf Coast)
3	945-964 27.91-28.47	111-130 96-113	Devastating damage: Total destruction of all pre-1994 mobile homes, extensive damage to all structures, unreinforced masonry buildings may collapse, high-rise windows blown out, electricity and water service unavailable for several days. (Fran – 1996- Atlantic Coast)
4	920-944 27.17-27.88	131-155 114-135	Catastrophic damage: Extensive damage as noted above, extensive windborne debris damage, high percentage of structural damage to multi-level apartment buildings, power and water outages for months, area uninhabitable.(Charley – 2004 – Florida West Coast)
5	<"920" <"27.17"	>"155" >"135"	Catastrophic damage: area uninhabitable for months, collapse of multi-story and industrial buildings. (Camille – 1969 – Atlantic Coast; Andrew-1992 – Florida; Katrina – 2005 – Gulf Coast)

Source: *National Hurricane Center, 2010*

SEVERE THUNDERSTORMS

Figure 4.2 Average Number of Thunderstorm Days Per Year (2015)



According to the National Weather Service, on average, the United States gets 100,000 thunderstorms each year. Although thunderstorms generally affect only a small area, the extent of their impact is often enhanced by their ability to generate tornados, hailstorms, strong winds, damaging lightning and flash floods. Approximately 1,000 tornadoes develop from these storms and large hail results in nearly $1 billion in damage to property and crops. Thunderstorms occur in all regions of the United States and are very common in the Rappahannock-Rapidan region where topographic and atmospheric conditions combine to create ideal circumstances for generating these powerful storms.

Thunderstorms form when moist, unstable air is lifted vertically into the atmosphere by (1) unequal heating of Earth's surface, (2) orographic lifting due to topographic obstruction of air flow, or (3) dynamic lifting along a front. Rising air cools and condenses forming cumulus clouds. Continued lifting and accompanying instability is needed for storm development. Thunderstorms may occur singly, in lines, or in clusters and may move through an area very quickly or linger in place for several hours.

LIGHTNING

Lightning is the discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm. The lightning flash occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes thunder.

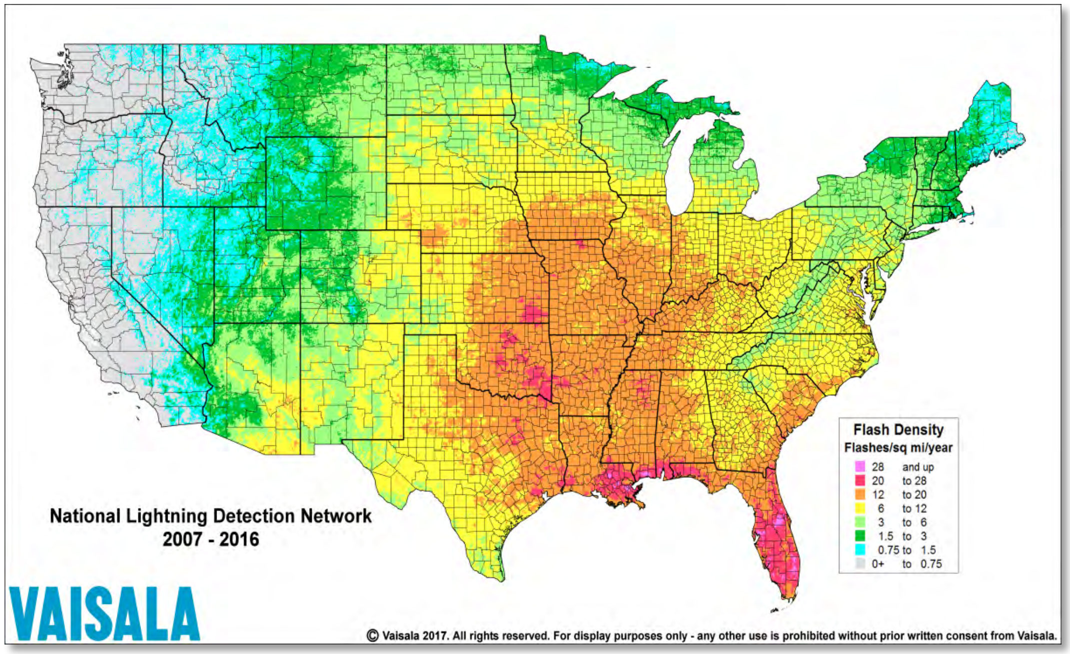


Figure 4.3 U.S. Lightning Flash Density

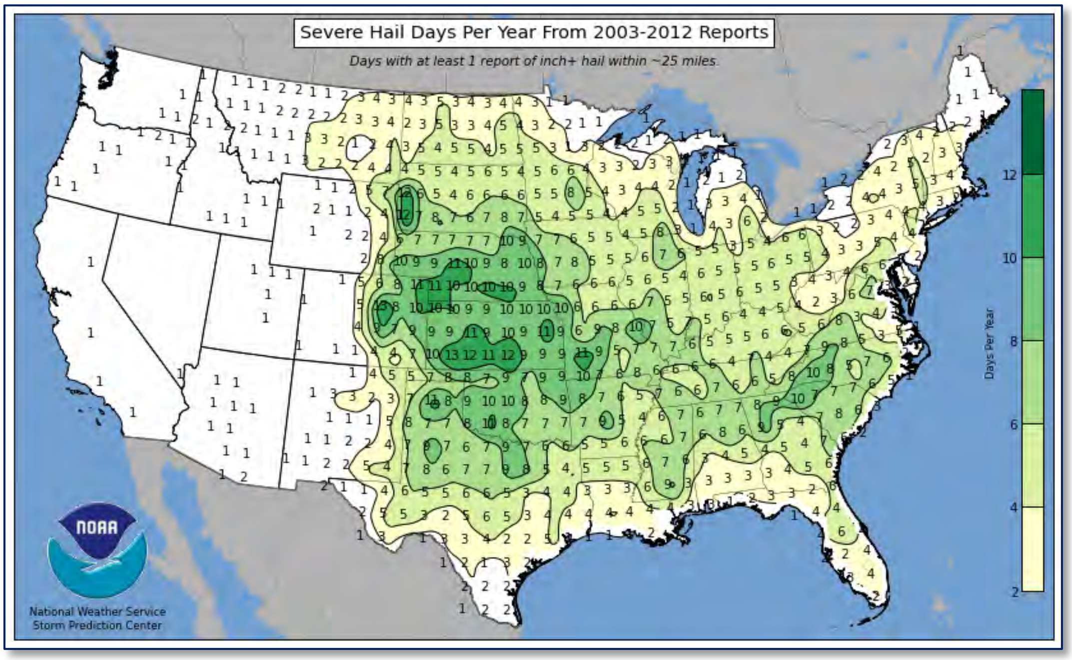
In 2016, Virginia ranked 10th nationally in lightning claims filed with State Farm, the largest homeowners insurer in the commonwealth and the nation. Virginia accounted for 3,331 lightning claims, at an average cost of $8,036 per claim and a total value of 26.8 million, (Spencer 2017).

Table 4.3 Virginia Lightning Statistics 1959-2005

Location	Deaths	Injuries
Open Space	16	39
Under Trees	17	52
On/Near Water	7	18
Golf Course	3	9
On Phone – land line	0	9
On/Near Heavy Equipment	3	9
Near Door/Window	3	15
Other/Unknown	17	18

HAIL

Hailstorms are usually associated with severe thunderstorms. High velocity updrafts within the storm carry ice crystals upward to regions of colder air where moisture precipitates on the crystal and freezes. The added weight causes the crystal to fall. If updrafts are strong enough, the crystal will make several trips up into higher, colder regions, adding a layer of ice each time. Once the weight of the pellet overcomes the force of the updraft, it falls to the ground as part of a hailstorm. Hail size directly reflects the severity of the storm.



Hail dents cars, shatters windows and green houses, damages roofs and damages or destroys crops. Farm animals may be injured. Every year areas of Virginia are impacted by severe thunderstorms producing large hail measuring 0.75-inch (penny size) or larger. Rarely, however, does the hail reach tennis ball size (2.5 inches) or larger. This large hail occurs once or twice per year on average

TORNADOS

Tornados are violent windstorms characterized by twisting, funnel-shaped clouds extending from a cloud mass to the ground. Usually generated by thunderstorm activity, they may be spawned by hurricanes and other intense low-pressure systems. Wind speeds range from 40 to 300 miles per hour. Damage from high winds, flying debris, lightning and hail is often extreme.

On average, there are about 1,200 tornados with 80 storm-related deaths and 1,500 injuries reported across the United States annually. Tornado season runs from late winter to mid-summer, with the majority of storms in the southeast occurring in the early part of the season. Tornados vary widely in wind speed and surface impact. Most are a few yards wide and touch down only briefly; however, extremely dangerous storms may extend over a mile in width and carve out a path of destruction several miles long. The storm's intensity, size and duration determine its impact.

As might be expected, tornados cause the greatest damage to lightly constructed buildings, particularly mobile homes. The Fujita-Pearson Scale for Tornados was developed to characterize tornado strength and associated damages. Although still commonly used, the Fujita Scale was revised in 2007 to reflect research by structural engineers and meteorologists who more precisely matched wind speed estimates with types of damage to 23 types of buildings and objects including trees, towers and poles. Modifications made to the original scale were limited to ensure that the new Enhanced F-scale could continue to support the original tornado database.

Table 4.4 Fujita Scale of Tornado & Winds Damage (1995-2017), & Enhanced Fujita (EF) Scale 2007

F Scale	Class	MPH	Damage	# in VA	%	Deaths / Injuries	Damage ($ Mil)	EF Scale	Class	MPH
F0	Weak	40-72	Light. Tree branches snapped; antennas and signs damaged.	239	51.1	0/19	7.9	**EF0**	Weak	65-85
F1	Moderate	73-112	Moderate. Roofs off; trees snapped; trailers moved or overturned.	184	39.3	3/86	38.8	**EF1**	Moderate	86-110
F2	Strong	113-157	Considerable. Weak structures and trailers demolished; cars blown off road.	33	7	1/50	112.2	**EF2**	Strong	111-135

F3	Severe	158-206	Roofs & some walls torn off well-constructed buildings; some rural buildings demolished; cars lifted and tumbled.	11	2.3	8/308	57.8	**EF3**	Severe	136-165
F4	Devastating	207-260	Houses leveled leaving piles of debris; cars thrown some distance.	1	.2	0/2	2	**EF4**	Devastating	166-200

Source: *VA Emergency*

In Virginia, tornados occur most frequently from April to September. The hot, humid conditions typical of these months often generate late afternoon or evening thunderstorms which may result in tornadic activity. Only one F/EF4 tornado has touched down in Virginia since 1995. The tornado travelled from Culpeper County in Rixeyville across the Fauquier County line, both within the Rappahannock-Rapidan Region. The tornado was 75 yards wide and seven miles long. The tornado destroyed three trailer homes in Ponderosa Trailer Court picking up one and dropping it in pieces 300 yards away. Two people were injured. Four churches, four trailer homes, four houses and numerous trees and powerlines were damaged in Jeffersonton. Two barns and a garage were destroyed. The tornado has winds of up to 210 mph at its peak and it was during the tornado's peak that it leveled a home. The Region is susceptible to powerful tornados as evidenced by the F4 tornado destructive force on September 24, 2001.

Table 4.5 Virginia Tornados by Month: 1991-2015 Average

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
>1	>1	>1	3	<2	<2	<2	<2	>4	>1	>1	0	<17

Source: *VA Emergency*

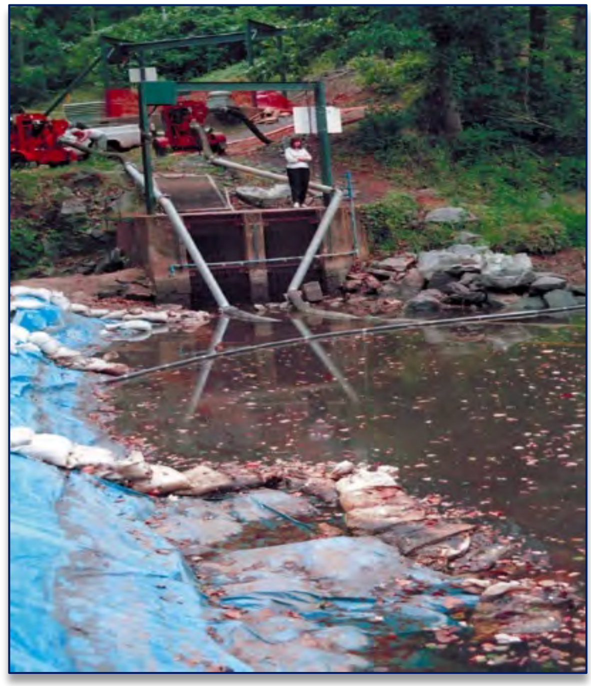
WILDFIRE

A wildfire is any unwanted or unplanned fire burning in forests or wildland areas that threatens to destroy life, property or natural resources. Each year, about 1,600 wildfires consume a total of 8,000-10,000 acres of forest and grassland in Virginia. During the fall drought of 2001, Virginia lost more than 13,000 acres to wildfires. Three percent of forest fires in Virginia are the result of lightning strikes; ninety-seven percent are caused by humans.

As Virginia's population continues to grow, so does the use of forests for recreation and residential development, thereby increasing the risk of wildfires. The wildland/urban interface, defined as the line, area or zone where structures and other human development meet or interface with undeveloped wildland or vegetative fuels, is an area of particular concern. Over the past 15 years the number of woodland home developments in Virginia has increased from 524 to 2,914 and the number of dwellings in those developments has gone from 18,203 to 138,111. Effective management of this increasingly fragile zone is essential to the conservation of forest resources and the preservation of the built environment.

Although possible anytime, wildfires in Virginia occur most often in Spring and Fall when the relative humidity tends to be lower, winds tend to be higher and fuels are cured to the point where they readily ignite. In hardwood stands, trees are bare, allowing sunlight to dry and warm the leaves on the forest floor. Fire activity fluctuates each month and varies from year to year. Adequate precipitation reduces fire potential; however, extended periods of warm, dry, windy weather increases fire occurrence. Drought conditions contribute to fire probability and may limit efforts to suppress wildfires in instances where decreased water supplies are inadequate to quickly contain the fire.

The potential for wildfires exists throughout the Rappahannock-Rapidan region; however, areas at greatest risk include those that are heavily forested or at the interface between forests and other land uses.   Land management measures including the development of fire roads, storage of water for emergency use, safety buffers, firebreaks, and fuel management can be developed as part of an overall fire defense system to aid in fire control. Education of those who use forested areas for recreation or build in wild land areas is of primary importance in reducing wildfires.



Town of Orange Rapidan River Intake Pump (2002) Drought

DROUGHT

Drought results from an extended period of limited precipitation affecting a fairly broad geographic area. High temperatures, high winds, and low humidity can exacerbate conditions, increasing the likelihood of wildfire. Human demands and actions can accelerate and intensify drought-related impacts. Droughts are classified as one of following: Meteorological, Agricultural, Hydrological, or Socio-economic. Meteorological droughts are typically defined in terms of precipitation deficits compared to average, or normal, amounts of precipitation over a given period. Crop and livestock needs, and soil water deficits are primary factors in determining agricultural droughts, while hydrological drought is directly related to the effect of precipitation shortfalls on surface water and groundwater supplies. Socio-economic drought results from precipitation shortages that limit the ability to supply water-dependent products to the marketplace. Weekly updated drought monitor maps may be viewed online at the National Drought Mitigation Center: http://drought.unl.edu/dm

Figure 4.5 US Drought Monitor Virginia (August 2017)

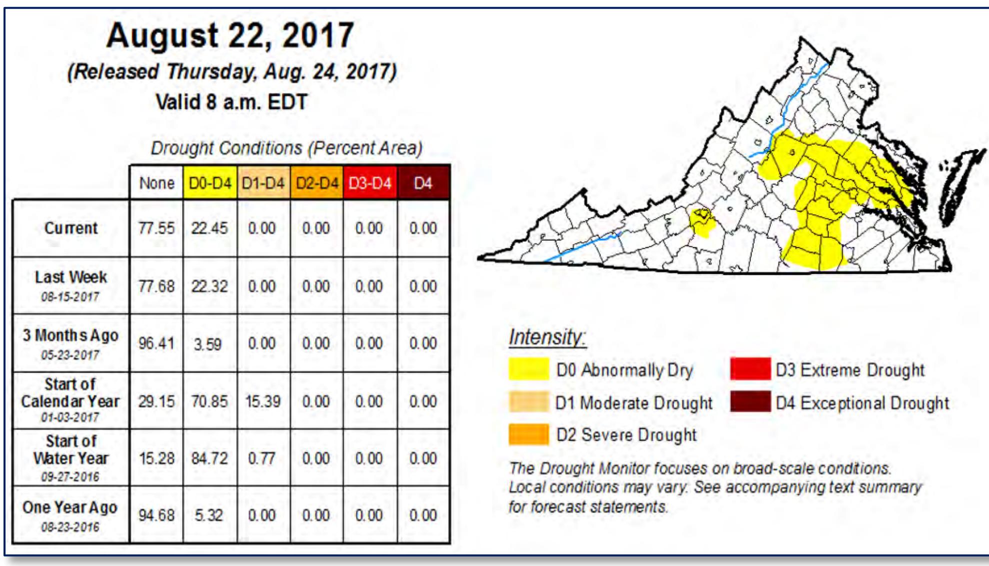
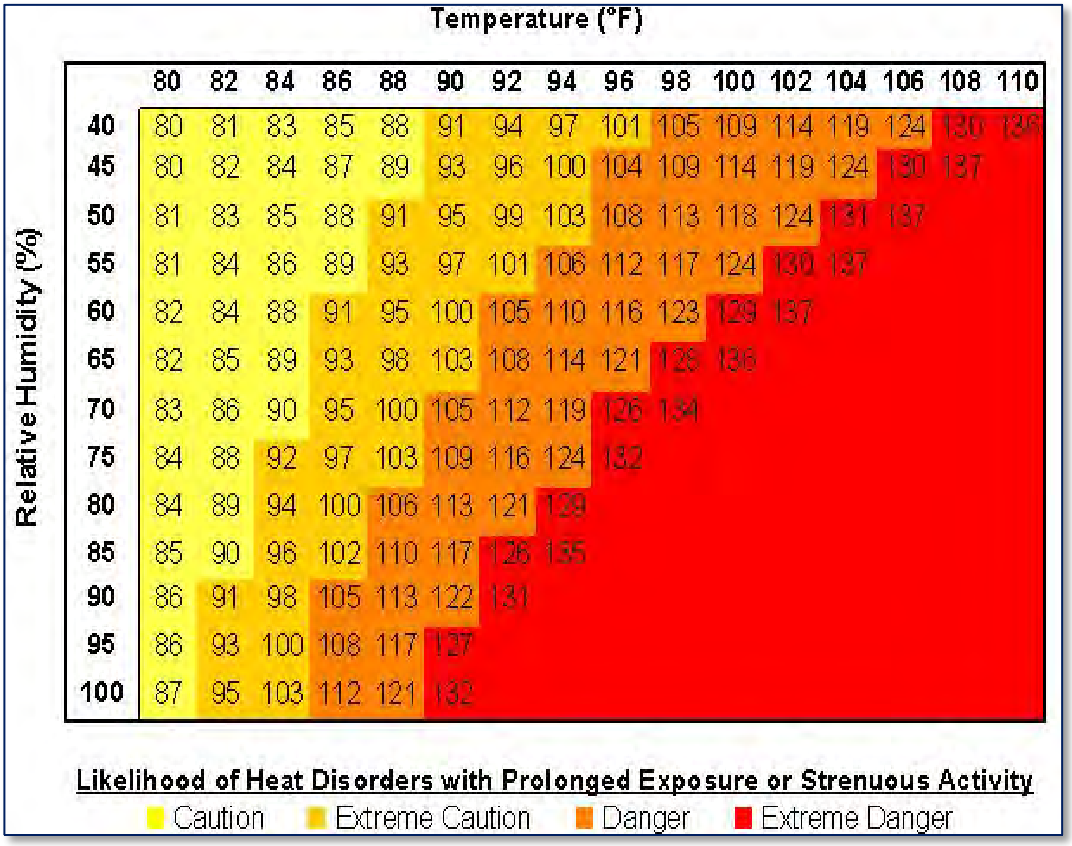


Table 4.6 Drought Severity Classification

Cat.	Desc.	Possible Impacts
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions

EXTREME HEAT

An extreme heat event is characterized by a prolonged period of temperatures 10 degrees or more above the average high temperature accompanied by high humidity. Under normal conditions, perspiration produced in response to elevated temperatures evaporates, cooling the body. High humidity, however, slows the evaporation process, resulting in discomfort and a greater challenge to the body to maintain normal temperatures. Elderly persons, young children, persons with respiratory difficulties, and those who are sick or overweight are more likely to become victims of extreme heat. Studies indicate that a significant rise in heat-related illness occurs when excessive heat persists for more than two days.



Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution Extreme Caution Danger Extreme Danger

Table 4.7 Heat Caution Index

Extreme heat in urban areas can create health concerns when stagnant atmospheric conditions trap pollutants, resulting in overall poor air quality. In addition, the urban heat island effect can produce significantly higher nighttime temperatures than those in surrounding suburbs. Exposure to two hours of air conditioning per day can significantly reduce the probability of heat-related illnesses.

WINTER STORMS & FREEZES

Winter storms are variable in their extent and duration. They can range from moderate, short-lived snowfalls to full-blown blizzards with blinding, wind-driven snow lasting several days. Some winter storms may be large enough to impact several states, while others may affect only a single community.

Winter storms may include a full range of precipitation, from snow, sleet, and freezing rain, to a mix of all three. Sleet hits the ground as a frozen solid, accumulating like snow and causing slippery conditions for pedestrians and motorists. Freezing rain, as the term suggests, falls as a liquid and freezes on contact, creating glazed surfaces and extreme hazards for all modes of mobility. Requiring surface temperatures below 32°F, freezing rain often results in multiple impacts. Even a limited accumulation can add significant weight to power lines and tree limbs, causing them to snap and break, disrupting communications and power, blocking roads and damaging structures.

A freeze is characterized by a minimum of several hours of temperatures around 30°F, or lower. Under these conditions, impacts to agriculture are significant, since all but the hardiest herbaceous plants will be affected. Nor'easters have a deserved reputation as Virginia's worst winter storms. They result from the interaction of two pressure systems sitting just offshore over the Atlantic. The counterclockwise rotation of a low-pressure system and the clockwise rotation of a high pressure system combine to bring wind and moisture to the East Coast from the northeast, hence the name. The ferocity of the storm depends on the strength, dynamics and interaction of the two systems. Nor'easters can erode low-lying coastal areas with damaging surf, glaze the region with layers of ice and deposit heavy snow across extensive areas. Typically, these storms occur from November through April, but are usually at their worst in January and February.

EROSION

Erosion is the transport by water, wind, ice and gravity of weathered materials on Earth's surface. The chemical and/or physical breakdown of rock produces loose particles which may continue to weather in place or be moved to the point at which the weight of the particle overcomes the energy of transport and the particle is deposited. Moving water is the primary agent of transport. Wind energy is second.

An increase in velocity of the agent of transport generally increases the size of the particle moved and distance over which it is transported. For example, heavy rainfall adds runoff to a stream. This results in an increase in stream velocity and the amount and particle size of sediment transported. Channel scouring and stream bank destabilization may follow.

Erosion potential is generally determined by a number of factors including surface composition, vegetative cover, topography, weather and climate. Loose, unconsolidated materials on steep slopes with no vegetative cover are far more likely to erode than compacted particles on vegetated plains. Vegetation plays a key role in controlling erosion. It intercepts the force of falling rain, absorbs runoff, slows the velocity of sheet flow and wind, and holds soil particles in place. As might be expected, the topography of an area also influences its susceptibility to erosion. The greater the gradient and slope length, the more areas are prone to erosion. Frequency, intensity and duration of rainfall also influence erosion potential.

Sound land management practices in construction and agriculture minimize the impacts of erosion including soil loss, stream degradation, landscape alteration, and landslides. As the importance of effective erosion control has gained increased attention, so have recognition of the need for regulatory programs and the development of erosion control products, practices and site development methodologies. Preservation and/or restoration of natural vegetation, other forms of stream bank stabilization, and the implementation of erosion and sediment control regulations are recognized as fundamental to managing erosion.

LANDSLIDES

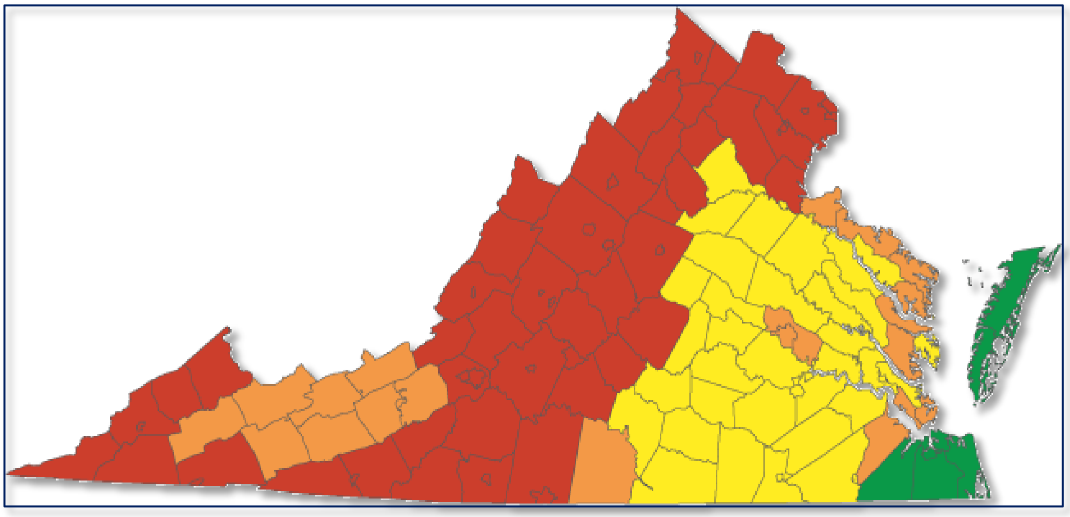
A landslide is the mass movement of earth material down a slope. The process is driven by gravity and may occur instantaneously with a sudden rush of rock and debris or imperceptibly as very slow movement over time. Landslides may be triggered by natural events such as heavy rainfall, rapid snow melt, stream incision, earthquakes and volcanic eruptions. Certain man-made changes to the land, such as slope modification or drainage alteration, can greatly increase the likelihood of landslides. Landslides are a major geologic hazard. They are widespread, occurring in all 50 states and U.S. territories.

Expansion of urban and recreational development into hillside areas results in increased threat of landslides each year. Landslides may wreck buildings, rupture gas, water and sewer mains, disrupt power and communication lines, and block transportation routes. Soil creep, slope slump, rock slides and debris flows cause property damage, injuries and death. In the United States, landslides cause up to $2 billion in damages annually and result in twenty-five to fifty fatalities. Areas prone to landslide hazards include those with historic susceptibility, bases of steep slopes, bases of drainage channels and developed hillsides where gravity flow septic systems are installed.

Aerial view of debris flow chutes and flood deposits from the June 27, 1995 flood at Kinsey Run, near Graves Mill in Madison County, Virginia.

Figure 4.6 Virginia Landside Risk

Counties in Virginia that are susceptible to landslides.
Red = high potential; orange = moderate potential; yellow = moderate to low potential; green = low potential



DAM FAILURES

With growing awareness of problems associated with aging infrastructure and recognition of populations in downstream areas, the concern for dam safety is increasing.   As knowledge of hydrology has increased, so has the interest in improved techniques in dam construction, maintenance and general operation.

According to the Army Corps of Engineers' National Inventory of Dams, there are 2, 919 dams in Virginia. 86 percent are privately owned. Other owners include federal, state and local authorities or agencies and public utilities. Dams help manage water for drinking, agriculture and navigation. They impound water to create lakes for recreation, to generate hydroelectric power and to manage floodwaters.

Dam failure can result from natural events, human-induced events, or a combination of the two. Failures due to natural events such as hurricanes, earthquakes or landslides are significant because there is generally little or no advance warning. Despite their many benefits, if not designed, constructed and maintained properly, dams may pose a significant risk to downstream communities. Dam failure includes the collapse, overtopping, breaching or other events that result in the uncontrolled release of water or sludge from an impoundment with subsequent downstream flooding. Dam or levee failures may occur with little warning. They may result from the effects of intense storms, debris jams or sudden snowmelt. Failure of even small structures can result in loss of life and significant property damage.

Dam failure may result from any one or combination of the following:

- Prolonged periods of rainfall and flooding;
- High winds creating erosion by wave action;
- Improper design, material selection; and/or construction;
- Inadequate spillway capacity;
- Internal structural erosion;
- Improper maintenance;
- Negligent operation;
- Failure of upstream structure(s);
- Intentional criminal acts.

Virginia's 2008 revisions to its dam classification and regulatory system brought it into alignment with that used in the National Inventory of Dams maintained by the U.S. Army Corps of Engineers. Hazard potential is directly related to anticipated adverse downstream impacts should the given dam fail.

Table 4.8 Dam Classification

Hazard Potential	Failure Effects	Inspection
High	Probable loss of human life, serious economic impact (buildings, facilities, major roads, etc.)	Annual, with inspection by professional engineer every 2 years.
Significant	May cause loss of human life or appreciable economic impact (buildings, secondary roads, etc.)	Annual, with inspection by professional engineer every 3 years.
Low	No expected loss of human life, no more than minimal economic impact.	Annual, with inspection by professional engineer every 6 years.

EARTHQUAKES

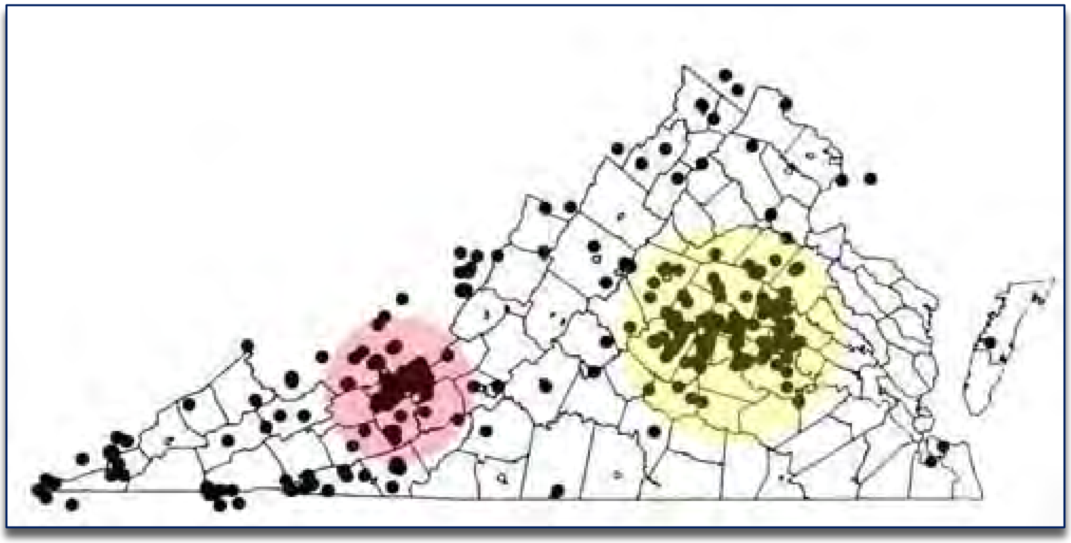
An earthquake is the movement of Earth's surface in response to radiated seismic energy resulting from volcanic or magmatic activity, slippage or buckling along tectonic plates or other sudden adjustments of subsurface stresses. Earthquake hazards include ground shaking, landslides, faulting, ground liquefaction, tectonic deformation and tsunamis. Earthquakes can result in widespread, extensive damage to the built environment, severe injury and loss of life, and the disruption of the social and economic fabric of the affected area.
Most property damage, injuries and deaths result from structural failure and collapse. The amount and type of damage relates directly to the amplitude and duration of motion which vary according to the size of the quake, its depth, location and regional geology.

The historic Ritz Hi-Hat building in downtown Culpeper, Virginia was destroyed by the August 23, 2011 earthquake. The picture above shows the demolition and removal phase one week after the earthquake.

Although the Pacific coastal area of the United States is far more likely to experience earthquakes than the eastern coastal region, earthquakes in the Central and Eastern U.S. are typically felt over a much broader region. East of the Rockies, an earthquake can be felt over an area as much as ten times larger than a similar magnitude earthquake on the west coast. Additionally, regions with historically limited seismic activity should not dismiss the possibility of future events. Earthquake prediction is not yet possible, and even small quakes can have significant secondary effects.

Virginia's past seismic activity has been concentrated in two areas: the central Piedmont along the James River, and the New River Valley in Giles County (see Fig. 4.14). Since all parts of the Commonwealth have experienced seismic activity in the past, however, the entire state should be considered susceptible to earthquakes.

Figure 4.7 Seismic Zones in Virginia



Giles County Seismic Zone – Pink; Central Piedmont Seismic Zone – Yellow (Source: Virginia DMME)

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is expressed by reference to the Richter Scale, an open-ended logarithmic scale that describes the energy released through a measure of shock wave amplitude. Each unit increase in magnitude on the scale corresponds to a ten-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale which is based on direct and indirect measurements of seismic effects. A detailed description of the Modified Mercalli Intensity Scale of earthquake intensity and its correspondence to the Richter Scale is given in Table 4.10**.**

Table 4.9 Richter Scale

Richter Magnitudes	Earthquake Effects
Less than 3.5	Generally not felt, but recorded.
3.5-5.4	Often felt, but rarely causes damage.
Under 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0-7.9	Major earthquake. Can cause serious damage over larger areas.
8 or greater	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Table 4.10 Modified Mercalli Intensity Scale for Earthquakes

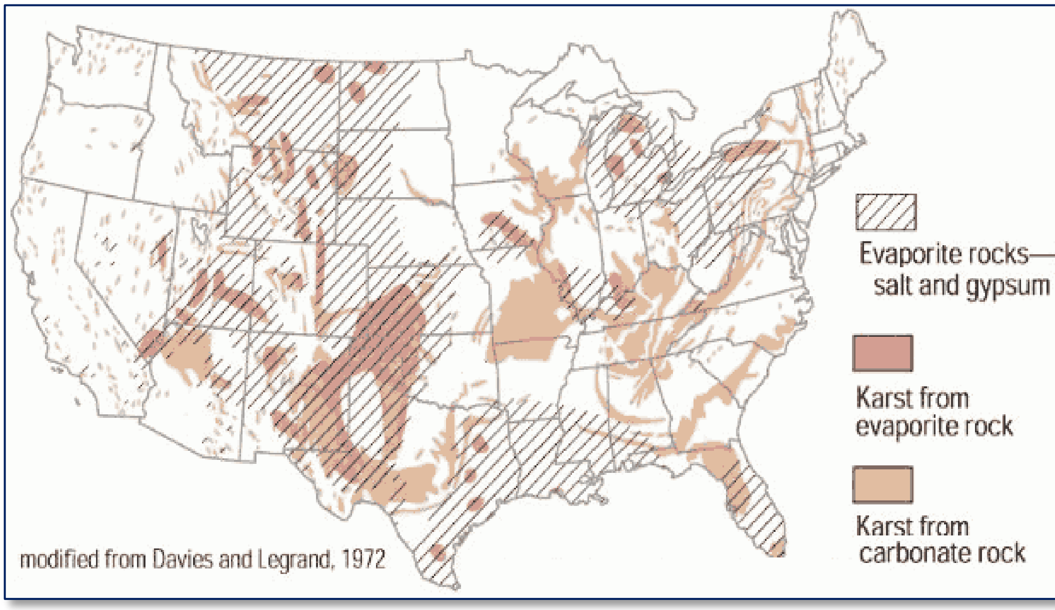
Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	Instrumental	Detected only on seismographs	
II	Feeble	Some people feel it	<4.2
III	Slight	Felt by people resting; like a truck rumbling by	
IV	Moderate	Felt by people walking	
V	Slightly Strong	Sleepers awake; church bells ring	<4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves	<5.4
VII	Very Strong	Mild Alarm; walls crack; plaster falls	<6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly	

		constructed buildings damaged	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open	<6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	<7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards	<8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves	>8.1

Source: *North Carolina Division of Emergency Management*

KARST & SINKHOLES

Figure 4.8 Areas of the US Prone to Sinkholes



'Sinkholes are common in areas characterized by soluble bedrock including limestone or other carbonates, salt beds, or any rock that can be dissolved naturally by circulating ground water (see Figure 4.15). These evaporite rocks underlie about 35 to 40 percent of the United States, though in many areas they are buried at great depths. As the rock dissolves, spaces and caverns develop underground. When the weight of the overlying land mass exceeds subsurface support, a sudden collapse may occur. The degree of susceptibility varies with the extent and character of the soluble rock, its location with regard to the water table and local climate conditions.

Sinkholes vary in size. Under natural conditions, sinkholes form slowly and expand gradually. However, human activities such as dredging, construction of impoundments, diversion of surface water, and groundwater removal can accelerate the rate of sinkhole development, resulting in an abrupt collapse. Although a sinkhole can form without warning, specific signs can signal potential development: Slumping or falling fence posts, trees, or foundations; Sudden formation of small ponds; Wilting vegetation, Discoloration of well water; and/or Structural cracks in walls, floors. Sinkhole formation is aggravated and accelerated by urbanization. Development increases water usage, alters natural drainage, overloads surface weight and redistributes surface materials. According to FEMA, insurance claims for damage resulting from sinkhole formation have increased 1,200 percent from 1987 to 1991, costing nearly $100 million.

DATA SOURCES: Section 4

American Society of Civil Engineers (ASCE), "Facts About Windstorms."
Web site: www.windhazards.org/facts.cfm
Bureau of Reclamation, U.S. Department of the Interior
Web site: www.usbr.gov
Federal Emergency Management Agency (FEMA)
Web site: www.fema.gov

National Climatic Data Center (NCDC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: http://lwf.ncdc.noaa.gov/oa/ncdc.html

National Drought Mitigation Center, University of Nebraska-Lincoln
Web site: www.drought.unl.edu/index.htm

National Severe Storms Laboratory (NSSL), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: www.nssl.noaa.gov

National Weather Service (NWS), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: www.nws.noaa.gov

Storm Prediction Center (SPC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service
Web site: www.spc.noaa.gov

The Tornado Project, St. Johnsbury, Vermont
Web site: www.tornadoproject.com

United States Geological Survey (USGS), U.S. Department of the Interior
Web site: www.usgs.gov

44 CFR Part 201.6(c) (2) (i): The risk assessment shall include a description of the type, location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

The *Hazard Analysis* provides information on historical hazard occurrences in Rappahannock-Rapidan Region for the natural and man-caused hazards listed below. This includes an assessment of the location and spatial extent of the event as well as best available data regarding the impact on the region.

NATURAL HAZARDS

- Flood
- Hurricanes, Tropical Storms and Nor'easters
- Severe Thunderstorms and Tornadoes
- Wildfire
- Drought/Extreme Heat
- Winter Storms and Freezes
- Earthquakes
- Land Subsidence (Karst and/or Sinkholes)
- Landslides/Erosion
- Dam Failure

Historical records were used to identify the level of risk within the planning area. This section includes series of maps that illustrate the location and spatial extent of those hazards within the Rappahannock-Rapidan Region that have a recognizable geographic significance, such as 100 year floodplains. For those hazards not confined to a particular geographic area, such as thunderstorms and tornadoes, general information on the applicable intensity of these events across the entire planning area is provided.

FLOOD

The most common hazard identified in the Rappahannock-Rapidan region is flooding. Three major rivers, the York, the Rappahannock and the Potomac, all of which have tributaries of significant size, drain the region to the Chesapeake Bay. Runoff from creeks and streams high in the Blue Ridge contribute to the downstream flow, often resulting in flash floods during periods of heavy rain and/or rapid snow melt.

Figure 5.1 illustrates the flood hazard areas for the entire region. The *Community Profile* section (Section 3 of this Plan) provides additional detail with regard to the region's geographic position within Virginia and other general geographic characteristics.

Table 5.1 lists flood events as reported by the National Climatic Data Center (NCDC) that have occurred in the Rappahannock-Rapidan region from 1/1/1995 until 12/31/2016. Because of the large number of events, details of only a few have been included. Historical evidence clearly illustrates the future likelihood of flooding in the region, with impacts ranging from localized (road closures due to high water) to region-wide events with riverine flooding on the major rivers in the region. Flood events also pose above average threats to property in the region with streams and tributaries passing through the region's most densely populated towns and developed areas.

Floods referenced below resulted in a total of 4 deaths, no reported injuries, approximately $4.2M in reported property damages and approximately $4.66M in crop damage claims. Details for events recorded in the National Climatic Data Center's database can be obtained by visiting http://www.ncdc.noaa.gov/oa/ncdc.html.

Figure 5.1 Flood Hazard Areas

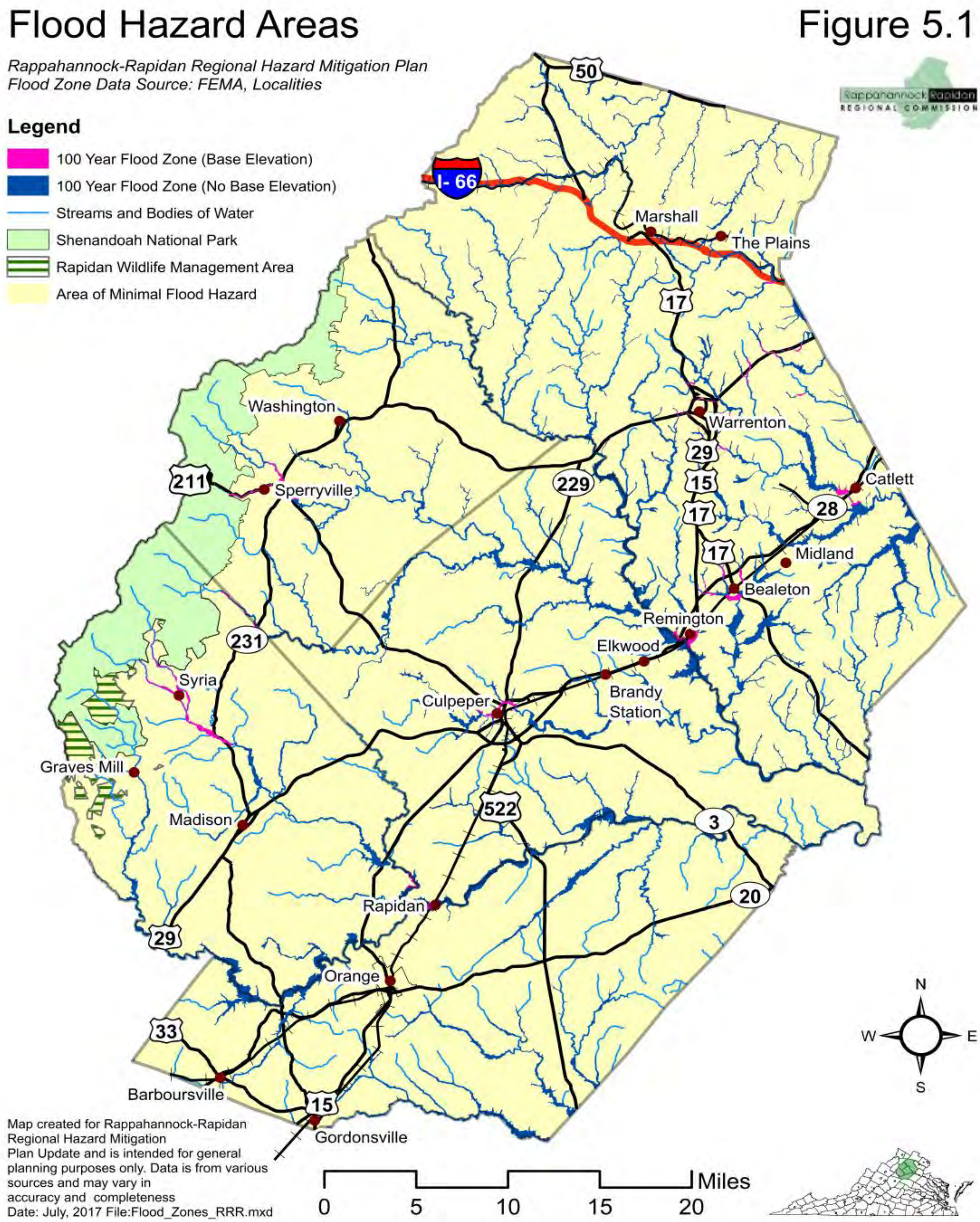


Table 5.1 Flood Events

Location	Number of Flood Events	Deaths	Injuries	Property Damage*	Crop Damage*
Culpeper County	87	4	0	$683,000	$800,000
Fauquier County	76	0	0	$323,300	$20,000
Madison County	67	0	0	$1,538,000	$2,750,000
Orange County	60	0	0	$768,300	$1,050,000
Rappahannock County	60	0	0	$892,500	$40,000
Regional Totals	350**	4	0	$4,205,100	$4,660,000

Source: *National Climatic Data Center Storm Events Database- Flood, Flash Flood, Debris Flow & Heavy Rain Event Types*
** Approximate numbers based on NCDC records.*
*** Many of the same events impacted more than one county*

Significant Flood Events

June 27, 1995 – Graves Mill, Madison County
On June 27, 1995, as much as 30 inches of rain fell in a 16-hour period on the steep slopes of Madison County, triggering hundreds of landslides and producing widespread flooding. Structures were inundated or crushed by flowing debris, pastures and crop-fields were obliterated and livestock perished. One fatality occurred near Crigglersville. Seven others lost their lives in different parts of the state as a result of this storm. Culpeper, Madison, Orange and Rappahannock counties were declared a major disaster area (FEMA).

January 19, 1996 – Entire region
Within twelve hours, rising temperatures melted the 20 – 30 inch snow cover. Snowmelt, along with 2 to nearly 5 inches of rain produced extensive regional flooding, the worst in over a decade. The event began with flash floods in the headwaters of all basins. River flooding progressed downstream through January 22nd. Crests ranged from 3 to 21 feet above flood stage. High water caused millions of dollars in damage, closed roads, destroyed homes and businesses, and forced the evacuation of several towns. Although low-water bridges were closed, a driver of a vehicle with 3 passengers dared the high waters of the Hazel River. All four perished as the automobile was swept downstream.

September 6, 1996 – Entire region
Along with significant wind damage, flooding resulted from heavy rains associated with Hurricane Fran. A major disaster was declared.

September 18, 2003 – Entire region
The combined effects of Hurricane Isabel's high winds and heavy rains and associated flooding, resulted in the declaration of a major disaster for the region and the Commonwealth.

June 2006
Rappahannock County was included with a number of other counties contiguous with the Rappahannock-Rapidan region in the declaration of a major disaster due to severe storms, tornadoes and flooding.

August 2015
Orlean in Fauquier County experienced a flash flood due to heavy rain. There was a road closed due to being washed out, and there was a five foot drop off left of the road.

May 2018
A period of heavy rain caused significant flooding in western Madison County and closed roads in Culpeper, Madison, and Orange counties. One death occurred due to the flooding in Madison County, however, the death was not noted in Table 5.1 above as the data is not yet recorded in the NCDC Storm Events Database.

FLOOD HAZARD AREA MAPS

Figures 5.2 through 5.11 illustrate in greater detail the flood hazard areas within each county and town, as applicable. It should be noted that the towns of Madison and Orange do not have any floodplains within their corporate boundaries.

Figure 5.2 Flood Hazard Areas: Culpeper County

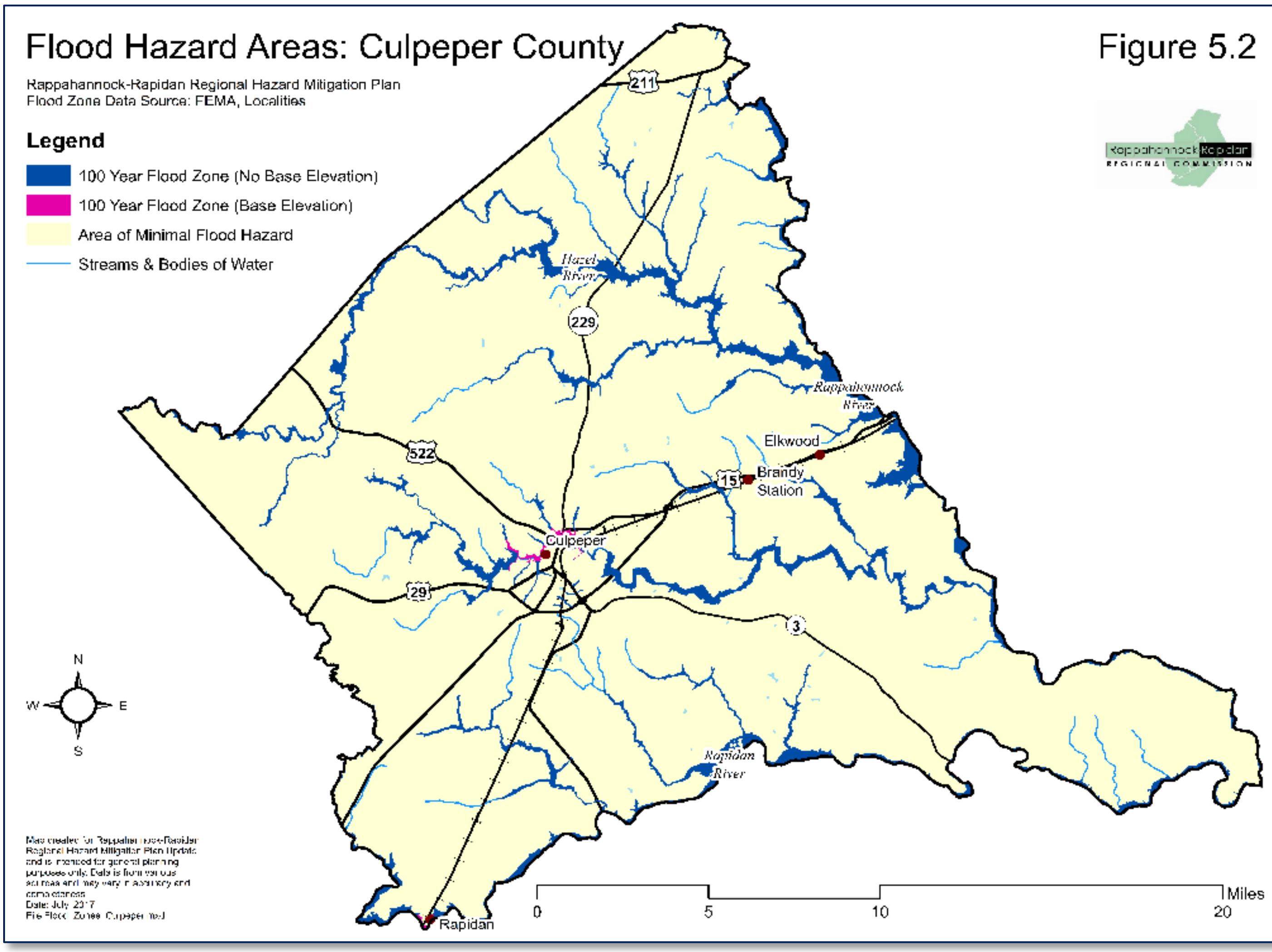


Figure 5.3 Flood Hazard Areas: Town of Culpeper

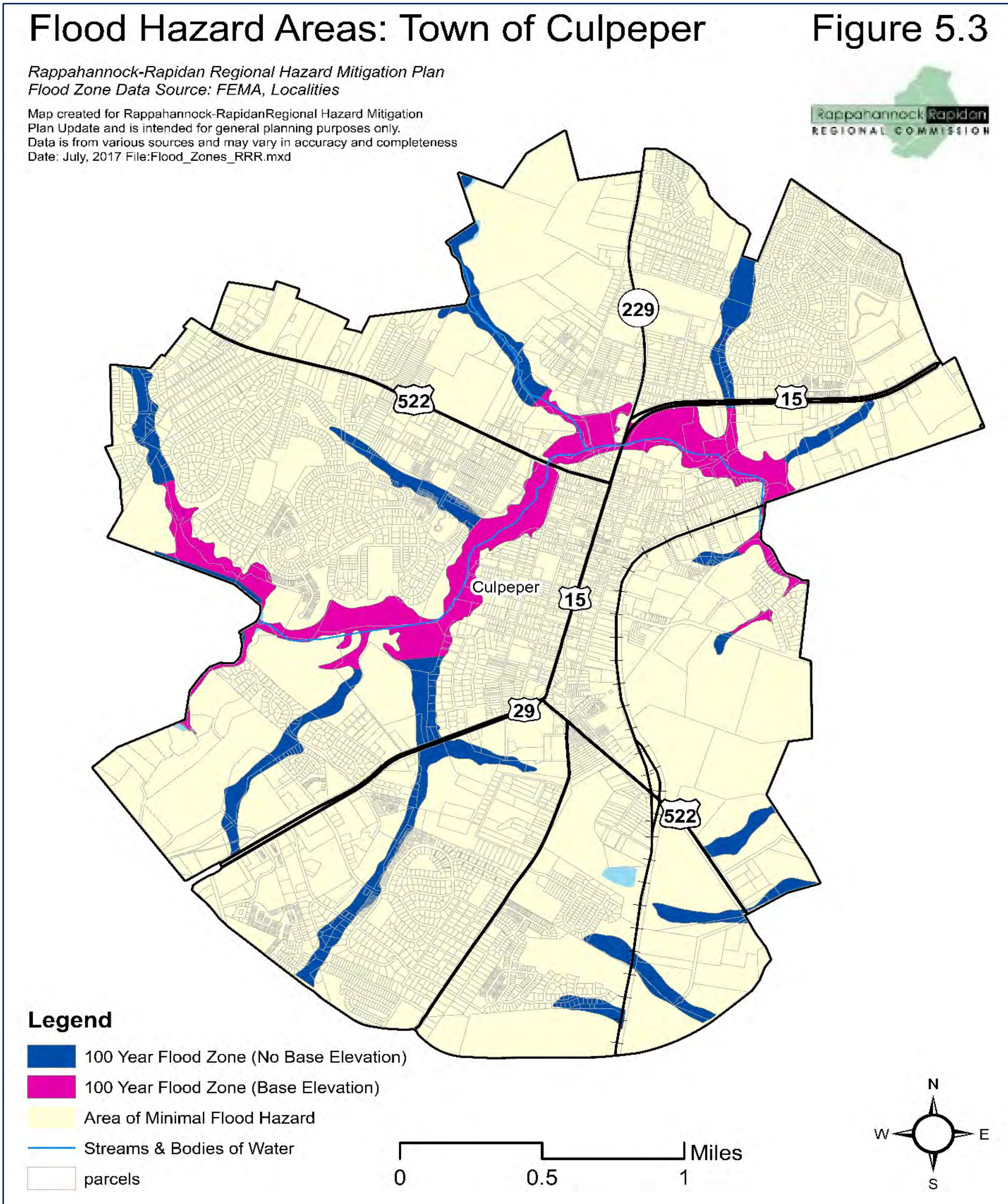


Figure 5.4 Flood Hazard Areas: Fauquier County

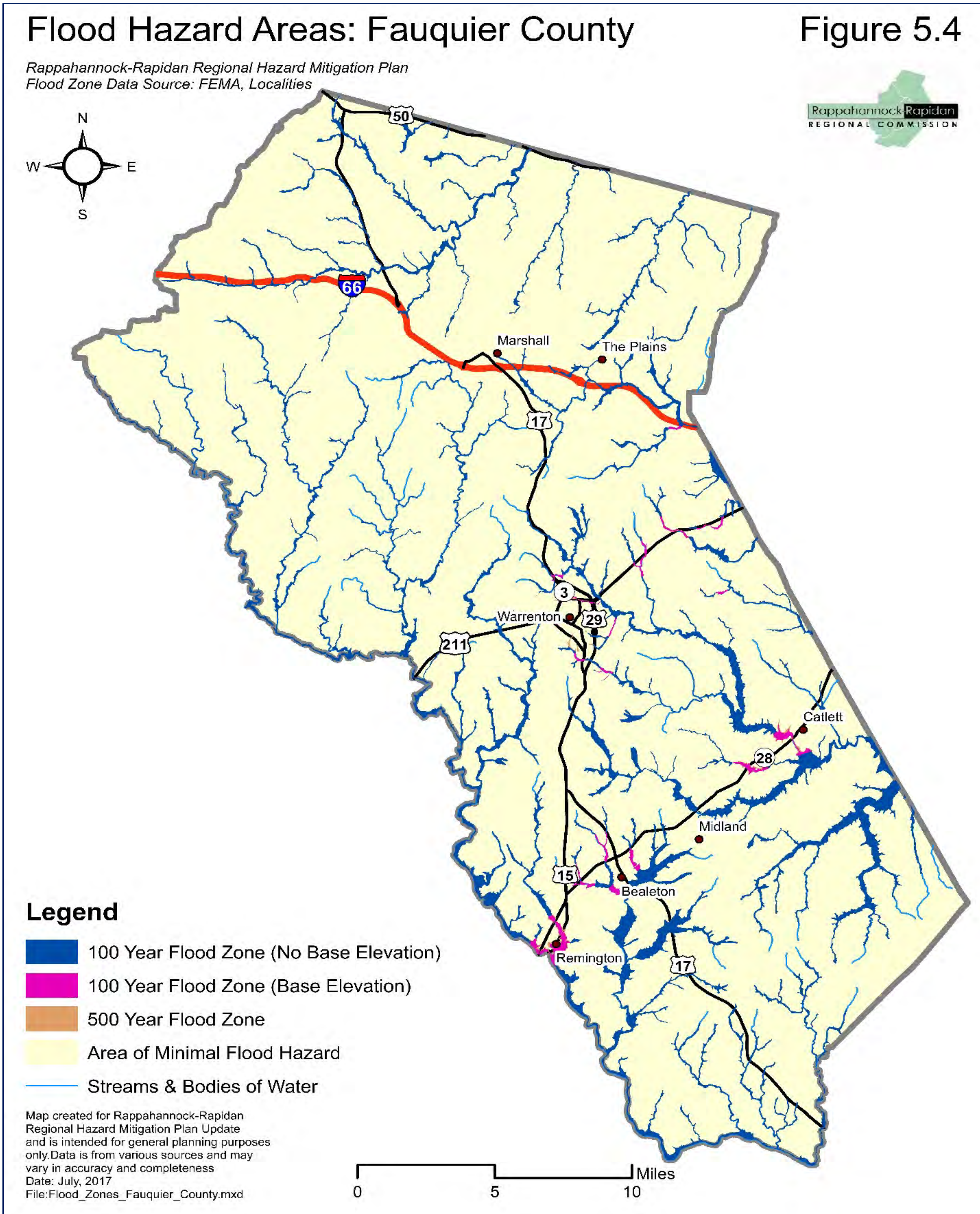


Figure 5.5 Flood Hazard Areas: Town of Remington

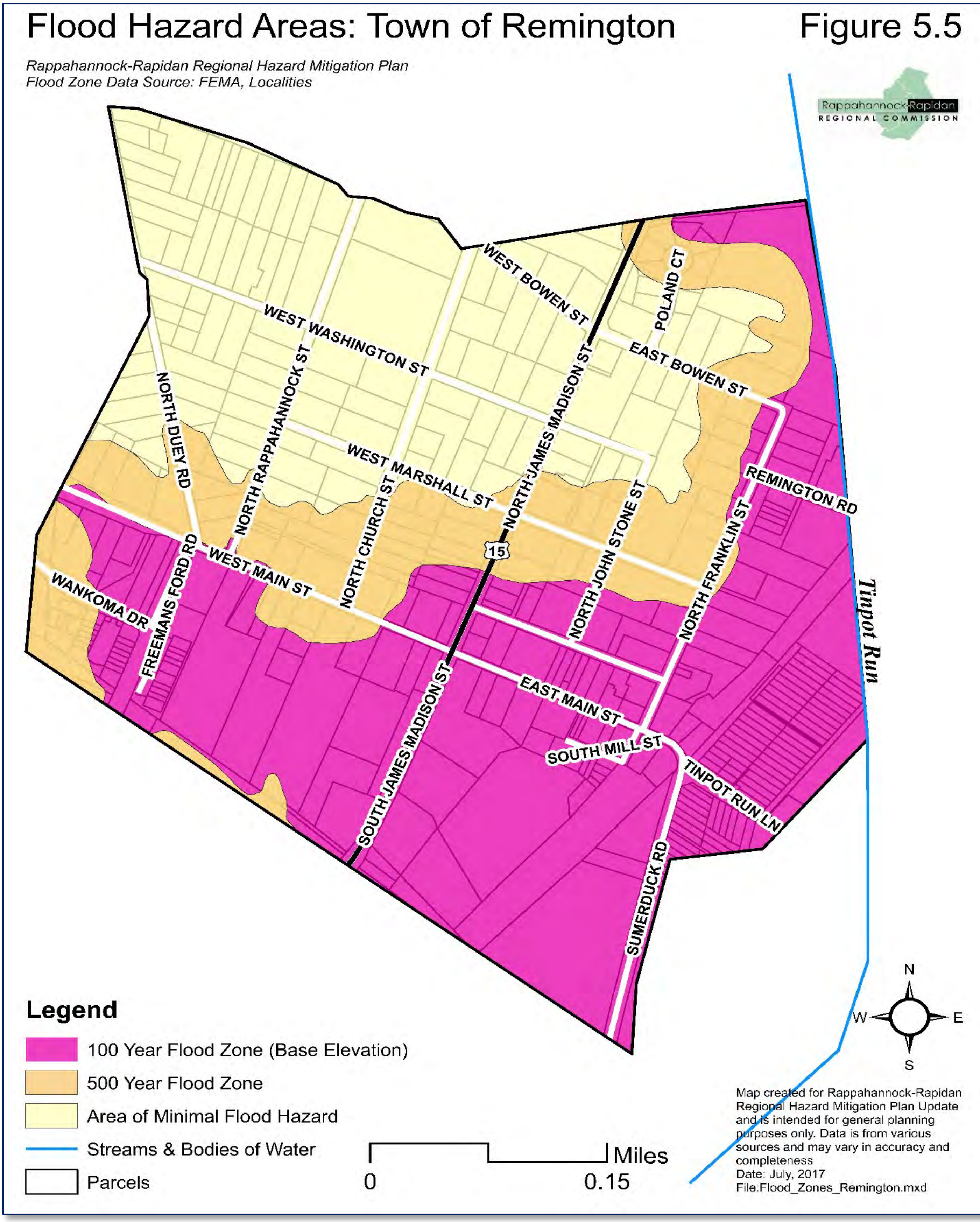


Figure 5.6 Flood Hazard Areas: Town of The Plains

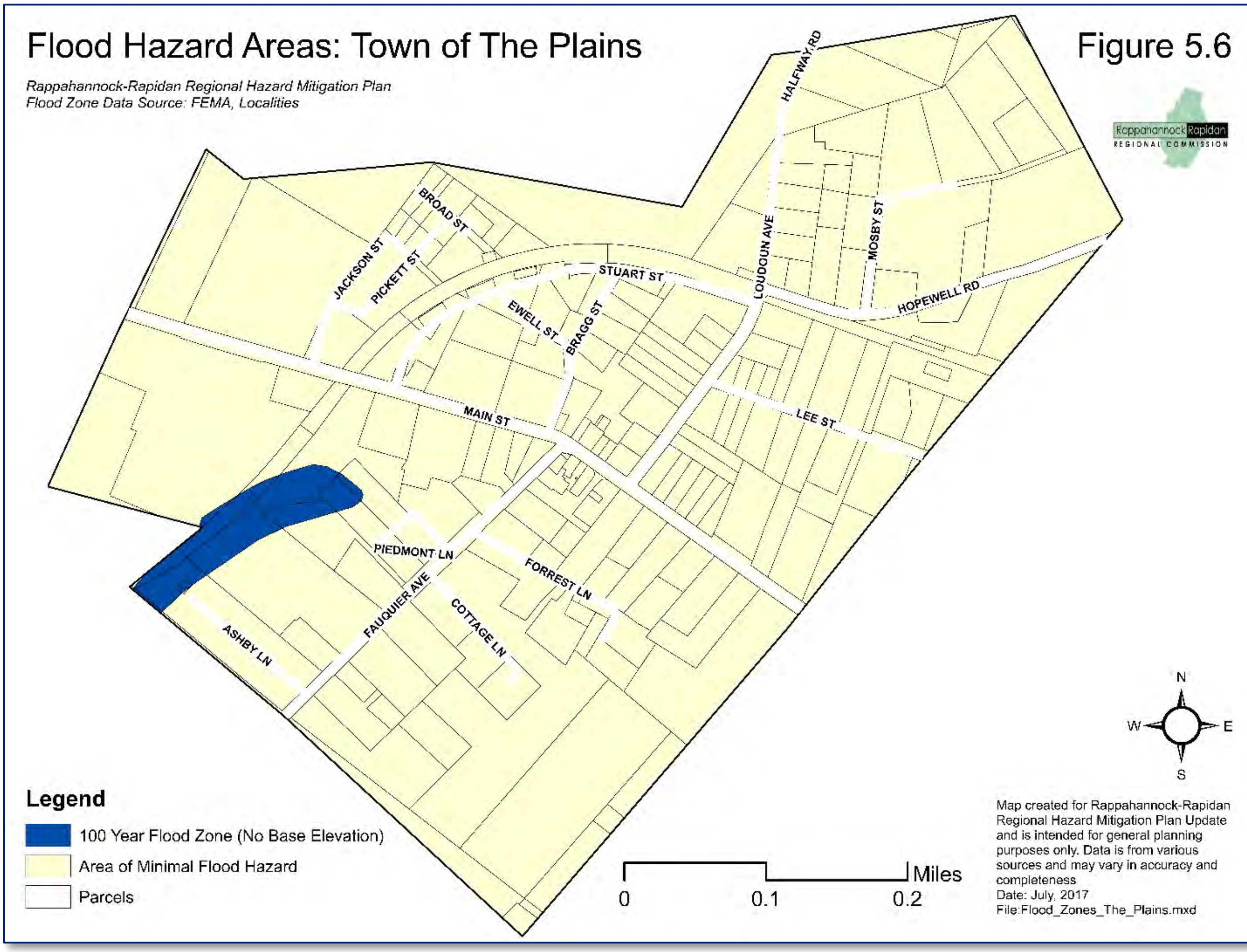


Figure 5.7 Flood Hazard Areas: Town of Warrenton

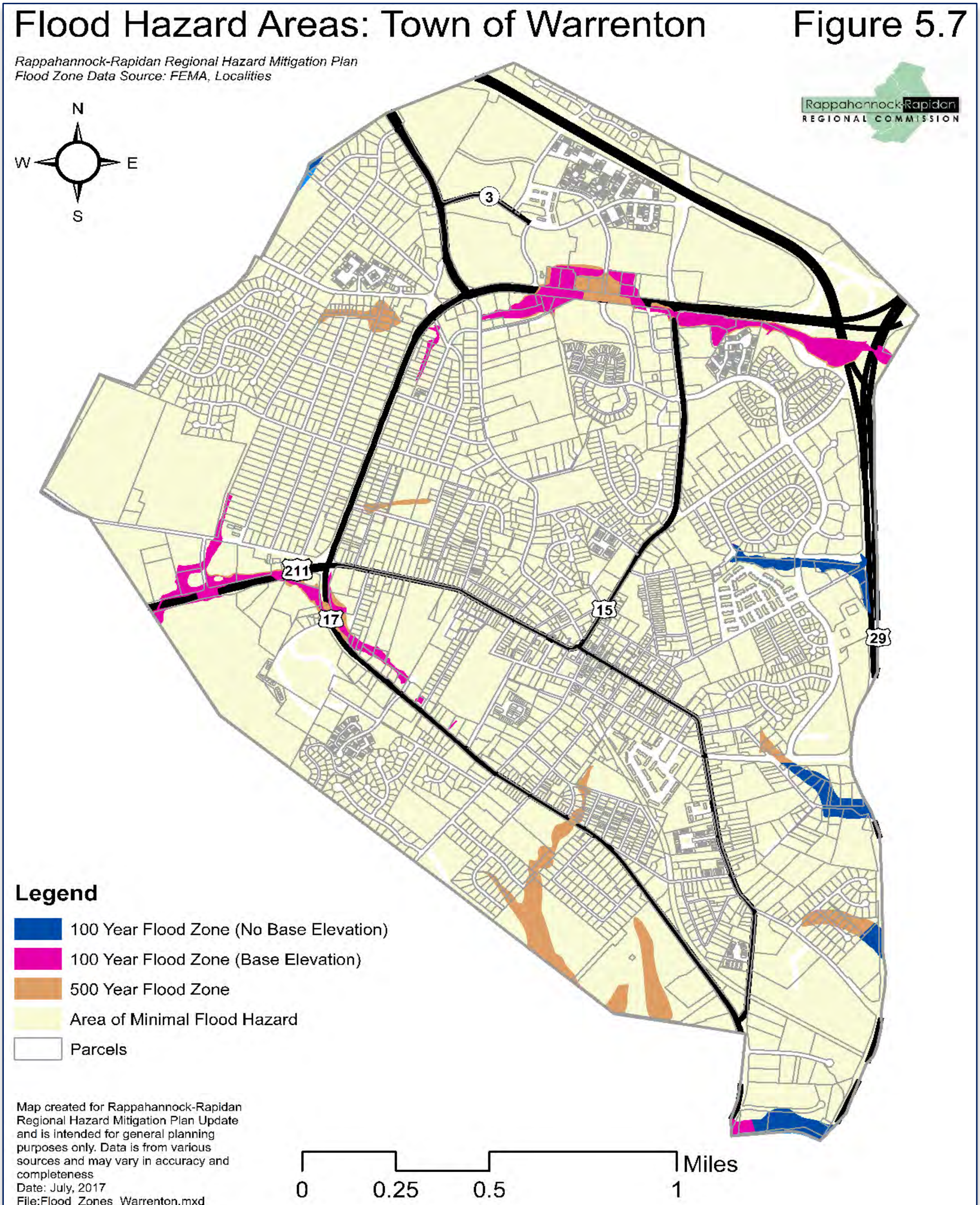


Figure 5.8 Flood Hazard Areas: Madison County

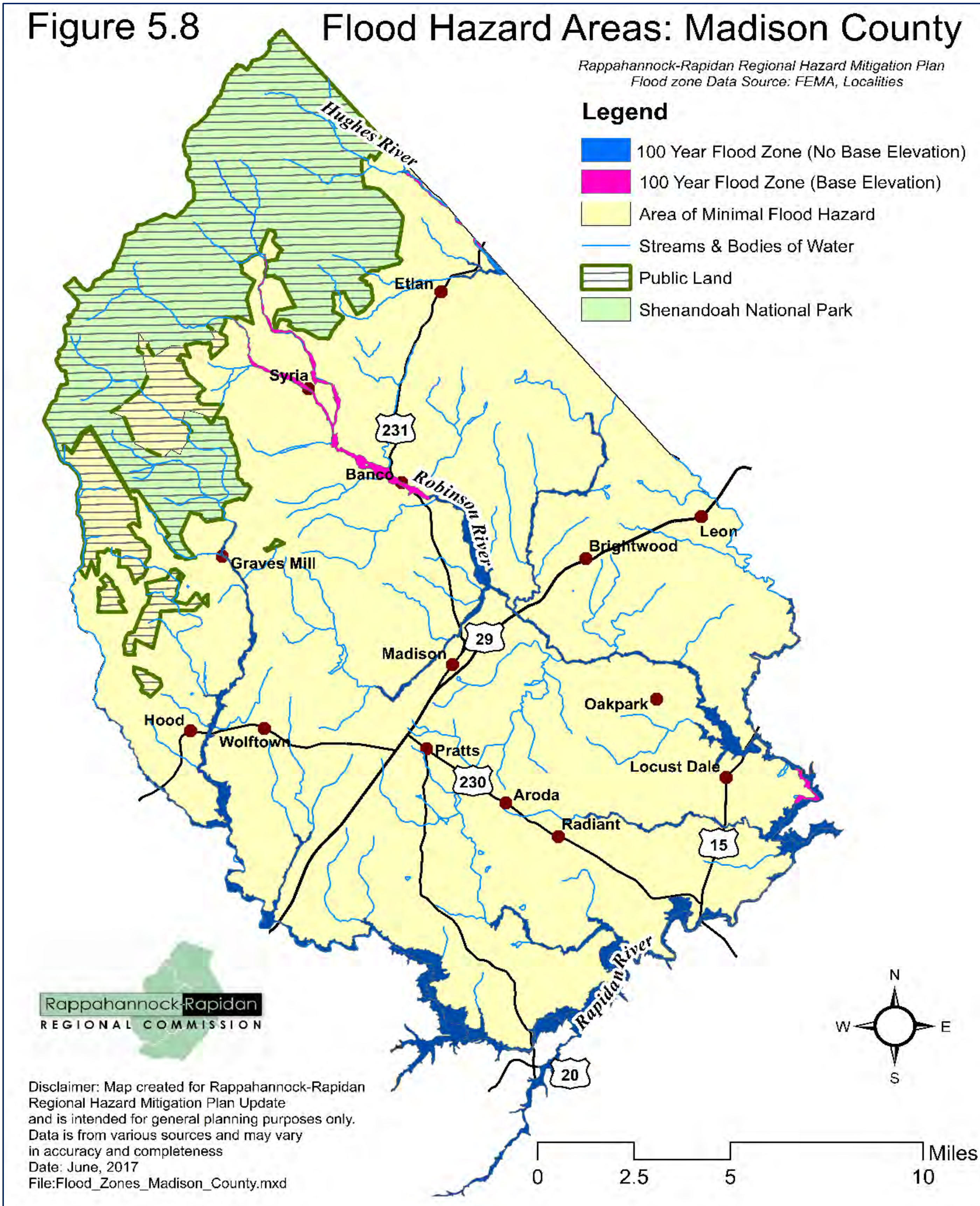


Figure 5.9 Flood Hazard Areas: Orange County

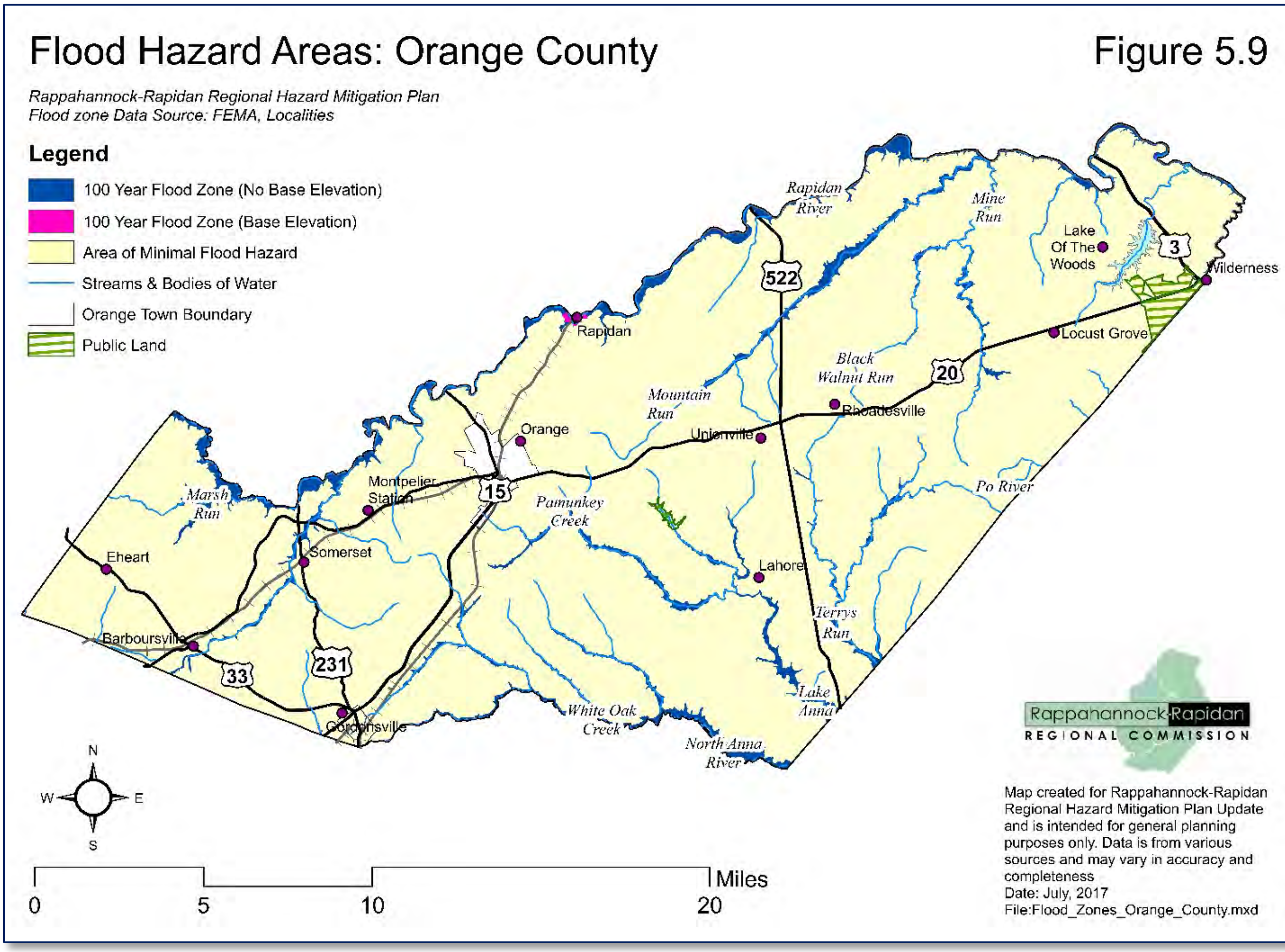


Figure 5.10 Flood Hazard Areas: Town of Gordonsville

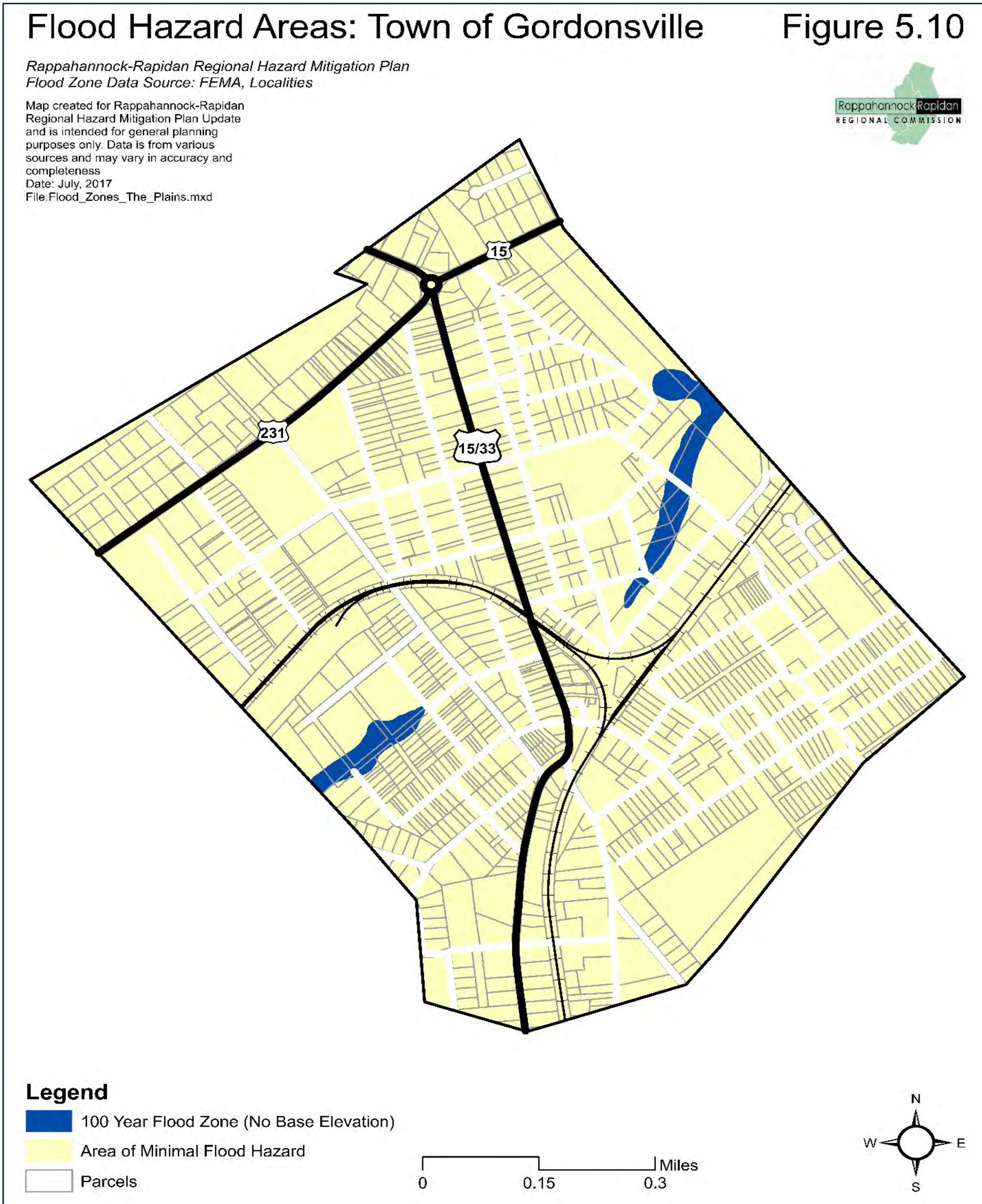


Figure 5.11 Flood Hazard Areas: Rappahannock County

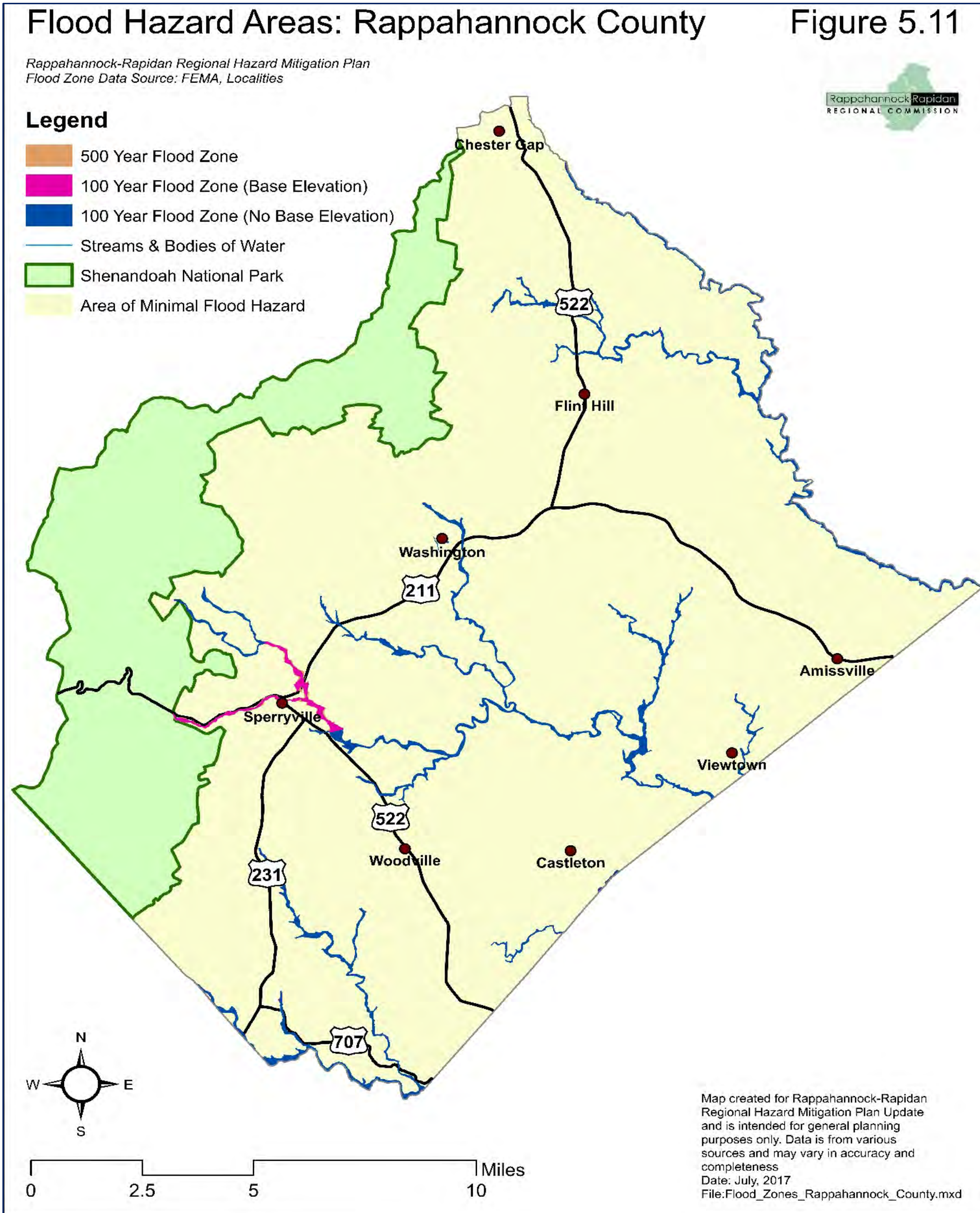
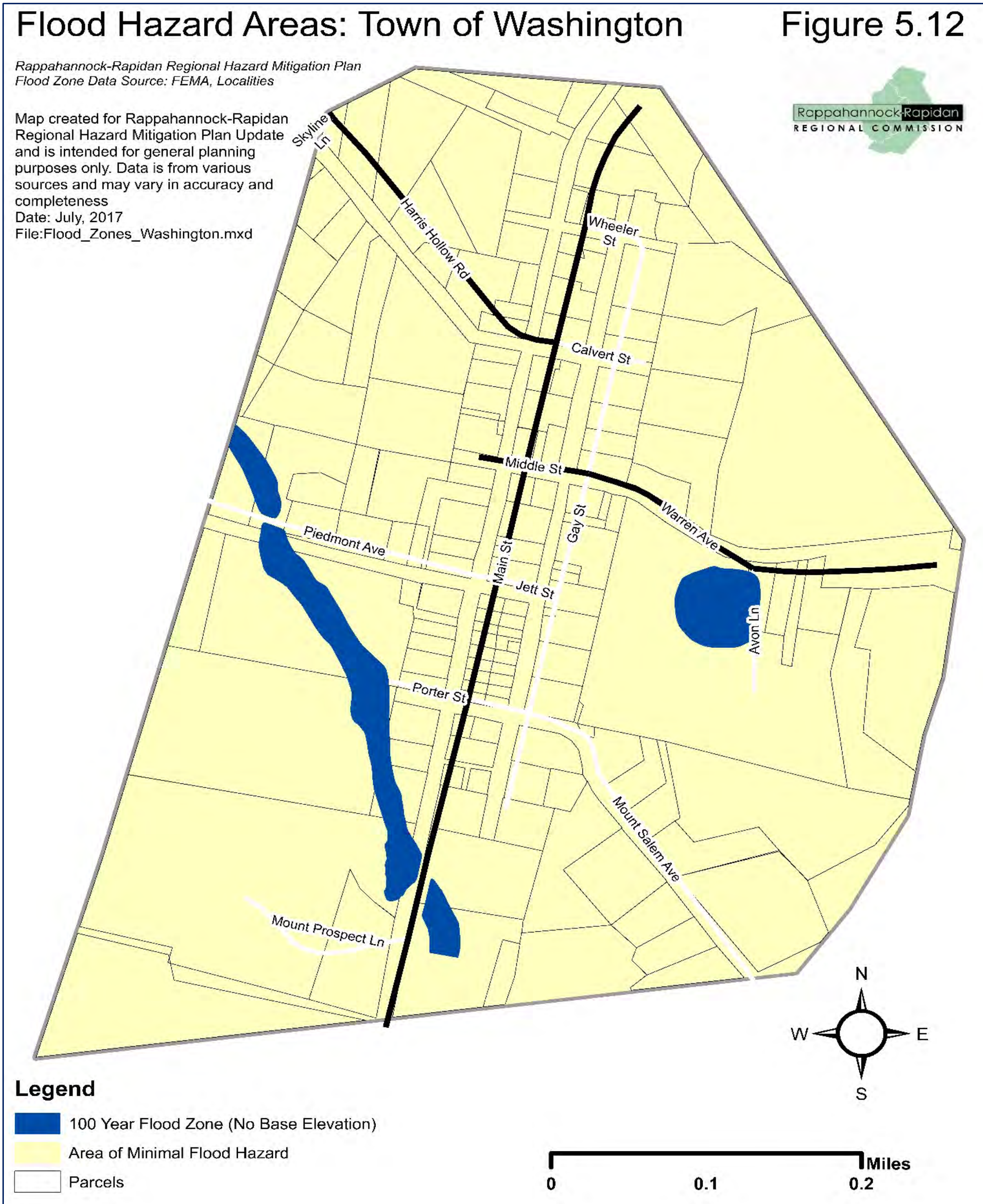


Figure 5.12 Flood Hazard Areas: Town of Washington



HURRICANES AND TROPICAL STORMS

Historically, very few hurricanes have tracked directly through the Rappahannock-Rapidan region. Since 1851, only four hurricanes – three unnamed and Hurricane Hazel in 1954, three tropical storms and four tropical depressions have passed directly through the region (Figure 5.12 – Historic Hurricane Tracks). Additionally, because the region is not located in a coastal zone, most of these hurricanes and tropical storms were weaker than at their peak strength when they passed through the Rappahannock-Rapidan region (Table 5.2). Historical evidence suggests hurricanes, tropical storms and nor'easters are likely to continue to impact the region albeit usually at lower than peak strength levels.

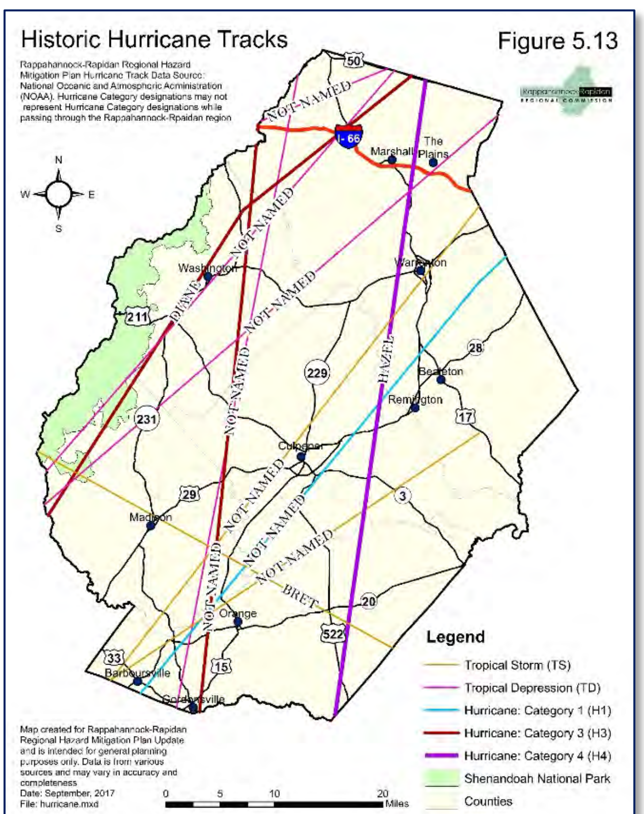
Table 5.2 Significant Tropical Cyclones

Name of Storm	Category (in region)	Date
Unnamed Tropical Storm	Tropical Storm	October 1885
Unnamed Hurricane	Tropical Storm	August 1893
Unnamed Hurricane	H1	September 1893
Unnamed Tropical Storm	Tropical Storm	October 1905
Unnamed Hurricane	Tropical Storm	August 1915
Unnamed Hurricane	Extratropical Storm	June 1934
Hurricane Able	Tropical Storm	August 1952
Hurricane Hazel	Extratropical Storm	October 1954
Hurricane Diane	Tropical Storm	August 1955
Tropical Storm Bret	Tropical Depression	June 1981
Tropical Storm Chris	Tropical Depression	August 1988
Tropical Storm Hanna	Tropical Storm	September 2008
Hurricane Irene	Tropical Storm	August 2011

Source: *National Hurricane Center*

**Note: Category indicates strength of storm in Rappahannock-Rapidan region, rather than highest strength of storm.*

Figure 5.13 Historic Hurricane Tracks



WINTER STORMS AND FREEZES

The most powerful storms to impact the Rappahannock-Rapidan region in winter are nor'easters. Unlike hurricanes, which usually move through the region in a 24-hour period, nor'easters may linger for several days delivering singly, or in combination, high winds, driving rain, heavy snow, sleet and ice. Structural damage, massive power outages and widespread travel problems are common products of such storms. Among the more memorable storms to impact the Rappahannock-Rapidan region are the following.

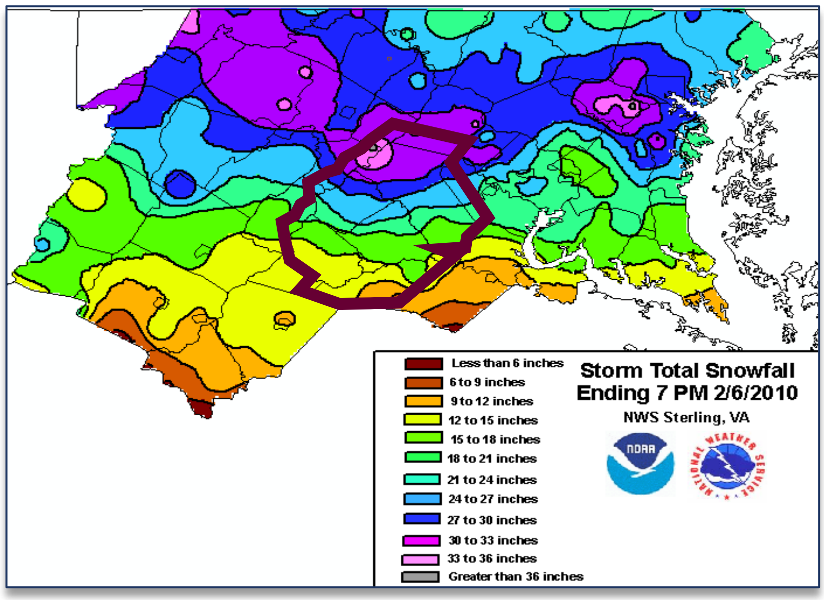
March 9, 1999: An area of low pressure moved from the Ohio Valley eastward, dropping heavy snow across the Appalachians. In the Rappahannock-Rapidan region light snow began around daybreak and intensified by mid-day. A localized band of heavy snow developed that stretched from the Eastern Panhandle of West Virginia, across Winchester, Middleburg and into Fairfax. In the heaviest band, snow fell at a rate of 2 inches an hour, making road clearing impossible.

Vehicles, stuck in snow and abandoned, clogged roadways. Both Reagan National and Washington-Dulles International airports were closed for most of the day. At least 200 abandoned, damaged, or stuck vehicles were towed from I-95 and I-66. Traffic accidents and related injuries were common throughout the region.

The back-to-back blizzards of **February, 2010**, paralyzed the region with unprecedented snowfall amounts that closed schools, businesses and government offices, challenged road clearing crews and tested the area's ability to respond to public needs in adverse conditions.

February 5-6, 2010: "Blizzard One." Snow began falling during the morning of the 5th. By 10 A.M. visibility was reduced to 1/2 mile. By early evening with moderate to heavy snow falling, visibility dropped to ¼ mile. Around midnight the effects of 35 mile per hour winds further reduced visibility to 1/16 of a mile. Northeasterly winds of 25-30 miles-per-hour persisted throughout much of the following day with visibility remaining extremely poor through 4 P.M. on the afternoon of February 6th. A total accumulation of 32" was recorded at Marshall, Virginia in the northeastern part of the region.

Figure 5.14 Regional Total Accumulations: 'Blizzard One'



February 9-10, 2010: Just one day after "Blizzard One" ended, a winter storm watch was issued. "Blizzard Two" followed. Light snow began to fall in the afternoon hours, of February 9. By midnight, conditions degraded rapidly. Visibility was reduced as wind speed increased. The fine, powdery snow blew around easily as wind gusts increased to 40-50 miles-per-hour, at times reducing visibility to less than 100 feet. Snow, strong gusty winds and poor visibility continued into the late afternoon of February 10th. Although totals for this storm were less than the first, deep drifts and high roadside snow banks created region-wide road-clearing problems. Accumulations of 6 to 10 inches were common throughout the region.

According to FEMA, the Rappahannock-Rapidan region was declared a major disaster area four times between 2000 and 2016 due to severe winter storms and snowstorms.

All counties were impacted by these storms which occurred on February 5 – 11(2 storms), 2010; December 18 – 20, 2009; January 25-31, 2000; and January 13, 2006.

Table 5.3 Significant Winter Storm Events, 1995-2015

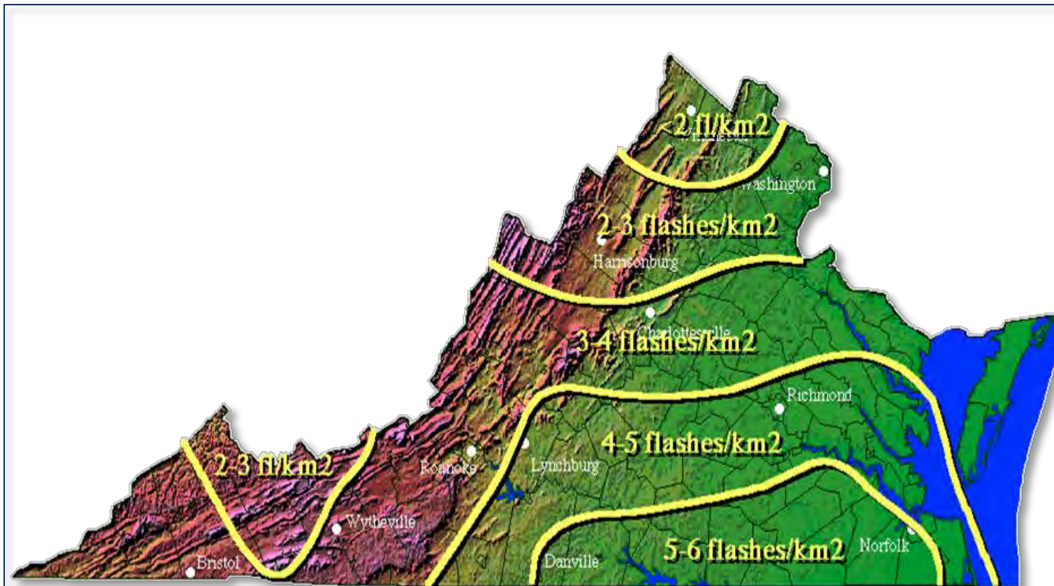
Location	Number of Events	Deaths	Property Damage*	Crop Damage*
Culpeper County	103	0	$2,151,000	$0
Fauquier County	98	0	$10,000	$0
Madison County	120	0	$51,250	$50,000
Orange County	95	0	$460,000	$0
Rappahannock County	126	0	$36,250	$50,000
REGIONAL TOTALS:	**542**	**0**	**$2,708,500**	**$100,000**

***Source**: National Climatic Data Center *Many of the same events impacted all counties, NCDC Event(s) include: Avalanche, Blizzard, Extreme Cold/Wind Chill, Heavy Snow, Ice Storm, Winter Storm, Winter Weather*

From 1995 through 2015, five extreme cold and wind-chill events were recorded. No deaths or injuries were directly related to extremely cold temperatures. Future winter storm events are likely to continue at historically recorded rates. Localities are all susceptible to significant winter storm events.

SEVERE THUNDERSTORMS AND TORNADOES

Figure 5.15 Virginia Lighting Strike Density Map



Source: Virginia State Climatology Office, 2010
Note: Map based on lightning strike data for 1989.

Thunderstorms are common throughout the Rappahannock-Rapidan region and, although most common in summer months, may occur at any time throughout the year. High winds, hail and dangerous lightning often accompany these events. In recent years, significant events include a derecho, also referred to as a straight-line wind event in June 2012, and numerous microburst events occurring as part of severe storm activity causing significant local damage throughout the region. Examples include damaging storms in April 2017 that caused significant damage in the Unionville area of Orange County along Route 522 and in many areas of Fauquier County, and a sustained wind event in March 2018 that caused numerous power disruptions and wildfires throughout the region. Severe thunderstorm events including related hail, lightning and microbursts have always been a common feature of the region but the frequency of these storm events has increased over the last twenty years. Severe thunderstorms and tornadoes are not limited to a specific geographic extent within the region and have the high potential to impact all localities within the region now and in the future.

Thunderstorms with wind gusts in excess of 58 mph (50 knots) and/or hail ¾" or more in diameter are classified as a “severe." Wind damage, flash floods, fires, crop and personal property damage may result from thunderstorms, which also may spawn tornados. Figure 5.15 summarizes the likelihood of lightning strikes, while Tables 5.4 and 5.5 provide data on occurrences and impacts of thunderstorms and related phenomena throughout the region.

Table 5.4 Significant Lightning Events, 1995-2015

Location	Number of Events	Deaths	Property Damage*	Crop Damage*
Culpeper County	4	1	$30,000	$0
Fauquier County	7	2	$56,000	$3,000
Madison County	2	0	$10,000	$0
Orange County	1	0	$500	$0
Rappahannock County	2	0	$10,000	$5,000
Regional Totals	**16**	**3**	**$106,500**	**$8,000**

Source: *National Climatic Data Center * Approximate numbers based on NCDC records. ** NCDC Event(s) include: Lightning*

Table 5.5 Severe Thunderstorms and Associated Winds, 1995-2015

Location	Number of Events	Injuries	Property Damage*	Crop Damage*
Culpeper County	119	0	$407,600	$10,750
Fauquier County	222	15	$1,504,000	$13,000
Madison County	85	0	$189,850	$7,500
Orange County	119	1	$550,300	$18,750
Rappahannock County	73	0	$254,600	$2,750
REGIONAL TOTALS:	**618**	**16**	**$2,906,350**	**$52,750**

Source: *National Climatic Data Center * Approximate numbers based on NCDC records. ** NCDC Event(s) include: Thunderstorm Winds*

Additionally, 173 hail events are known to have occurred in the region from 1995-2015 (NCDC, 2017). The number of events and amount of damage per county are summarized in Table 5.6.

Table 5.6 Hail Events, 1995-2015

County	Number of Hail Events	Property Damage*	*Crop Damage**
Culpeper	36	$90,000	$20,000
Fauquier	63	$2,011,000	-
Madison	18	$60,500	$60,000
Orange	35	$3,000	-
Rappahannock	21	$7,000	-
TOTALS:	**173**	**$2,171,500**	**$80,000**

Source*: National Climatic Data Center * Approximate numbers based on NCDC records.*
NCDC Event(s) include: hail

Significant Hail Events

April 23, 1999 – Upperville
A line of thunderstorms developed in West Virginia during the early afternoon and moved rapidly southeast across Northern Virginia. These storms produced very large hail that damaged cars, roofs, siding, windows and landscaping. Over $1 million in damage was attributed to these fast moving storms.

May 13, 2000 – Warrenton
A band of thunderstorms produced golf ball to tennis ball sized hail in Warrenton. Hundreds of cars, roofs and windows were damaged in an amount exceeding $1 million. Walnut sized hail was reported in the northwest portion of the county where winds gusted to 65 miles per hour.
On June 18, 2008, Orange County experienced a complex and destructive weather event. According to the National Weather Service, a cold front with associated thunderstorms moved across the Appalachians eastward toward Orange County. Heavy rain, severe lightning, and ping-pong ball size hail accompanied the storm. Local crops sustained substantial damage. As a local newspaper noted, "Early-planted corn had trouble standing up to the ping pong ball-sized hail that fell across the area." Sandy James of The Orange County Review documented the damage.

TORNADOES

Virginia averaged 16 tornadoes and one death per year from 1985-2014 (Storm Prediction Center, 2017). From January 1995 through December 2016, the Rappahannock-Rapidan region experienced 39 tornado events. Tornadoes are likely to continue at or around historical frequencies with Fauquier, Culpeper and Orange counties being relatively evenly susceptible and Madison and Rappahannock counties being a little less susceptible to tornado events. Madison and Rappahannock counties are the two smallest counties by land area in the region and also have large land areas with mountainous terrain. Tornadoes can and do hit mountains, however, mountains have colder and therefore more stable air than in lower elevation areas. Conditions are generally less suitable for tornadoe formation in mountainous regions. Fauquier County is the largest county in the region at 648 sq. miles with the second largest county being Culpeper at 379 sq. miles, and third Orange County at 341 sq. miles. The dispersion and frequency of tornado events across the Rappahannock-Rapidan Region is likely to stay relatively consistent with historic counts.

Table 5.7 Tornadoes, 1995-2015

County	Date	F-Scale	Deaths	Injuries	Property Damage	Crop Damage
Culpeper	9/20/2001	F0	0	0	$0	0
	9/24/2001	F4	0	2	$2,000,000	0
	7/10/2003	F0	0	0	$0	0
	9/8/2004	F1	0	0	$50,000	0
	9/17/2004	F1	0	0	$850,000	0
	9/17/2004	F1	0	0	$150,000	0
	8/30/2005	F0	0	0	$5,000	0
	6/4/2008	F0	0	0	$15,000	0
Total	**8**		**0**	**2**	**$3,070,000**	**0**
Fauquier	9/24/2001	F1	0	0	$20,000	0
	9/24/2001	F1	0	0	$180,000	0
	5/7/2003	F1	0	0	$12,000	0
	9/8/2004	F2	0	0	$500,000	0
	9/8/2004	F1	0	0	$7,000	0
	9/8/2004	F0	0	0	$2,000	0
	9/17/2004	F3	0	2	$250,000	0
	9/17/2004	F2	0	0	$500,000	0
	9/17/2004	F2	0	0	$750,000	0
	8/30/2005	F0	0	0	$50,000	0
	8/30/2005	F1	0	0	$1,500,000	0
	6/4/2008	F0	0	0	$15,000	0
	6/4/2008	F1	0	0	$25,000	0
	3/10/2011	F1	0	0	$25,000	0
	10/13/2011	F0	0	0	$30,000	0
Total	**15**		**0**	**2**	**$3,866,000**	**0**
Madison	9/10/1997	F1	0	0	$15,000	$5,000
	8/9/2000	F1	0	0	$15,000	0
	5/2/2004	F1	0	0	$8,250	0
	9/17/2004	F2	0	0	$200,000	0
	8/30/2005	F0	0	0	$10,000	0
Total	**5**		**0**	**0**	**$248,250**	**$5,000**
Orange	7/21/1995	F1	0	0	$80,000	0
	9/10/1997	F0	0	0	0	0
	7/24/1999	F1	0	0	$50,000	0
	9/24/2001	F1	0	0	$5,000	0
	6/6/2002	F1	0	0	$10,000	0
	9/8/2004	F0	0	0	$5,000	0
	9/17/2004	F1	0	0	$150,000	0
	9/17/2004	F2	0	0	$75,000	0

County	Date	F-Scale	Deaths	Injuries	Property Damage	Crop Damage
	10/13/2011	F0	0	0	$5,000	0
Total	**9**		**0**	**0**	**$380,000**	**0**
Rappahannock	08/30/2005	F0	0	0	$50,000	0
	07/23/2008	F0	0	0	$15,000	0
Totals	**2**		**0**	**0**	**$65,000**	**0**
RRRC Total	**39**		**0**	**4**	**$7.63M**	**$5,000**

Source: *National Climatic Data Center, NCDC Event(s) include: Tornados*

Figure 5.16, Historic Tornado Strikes

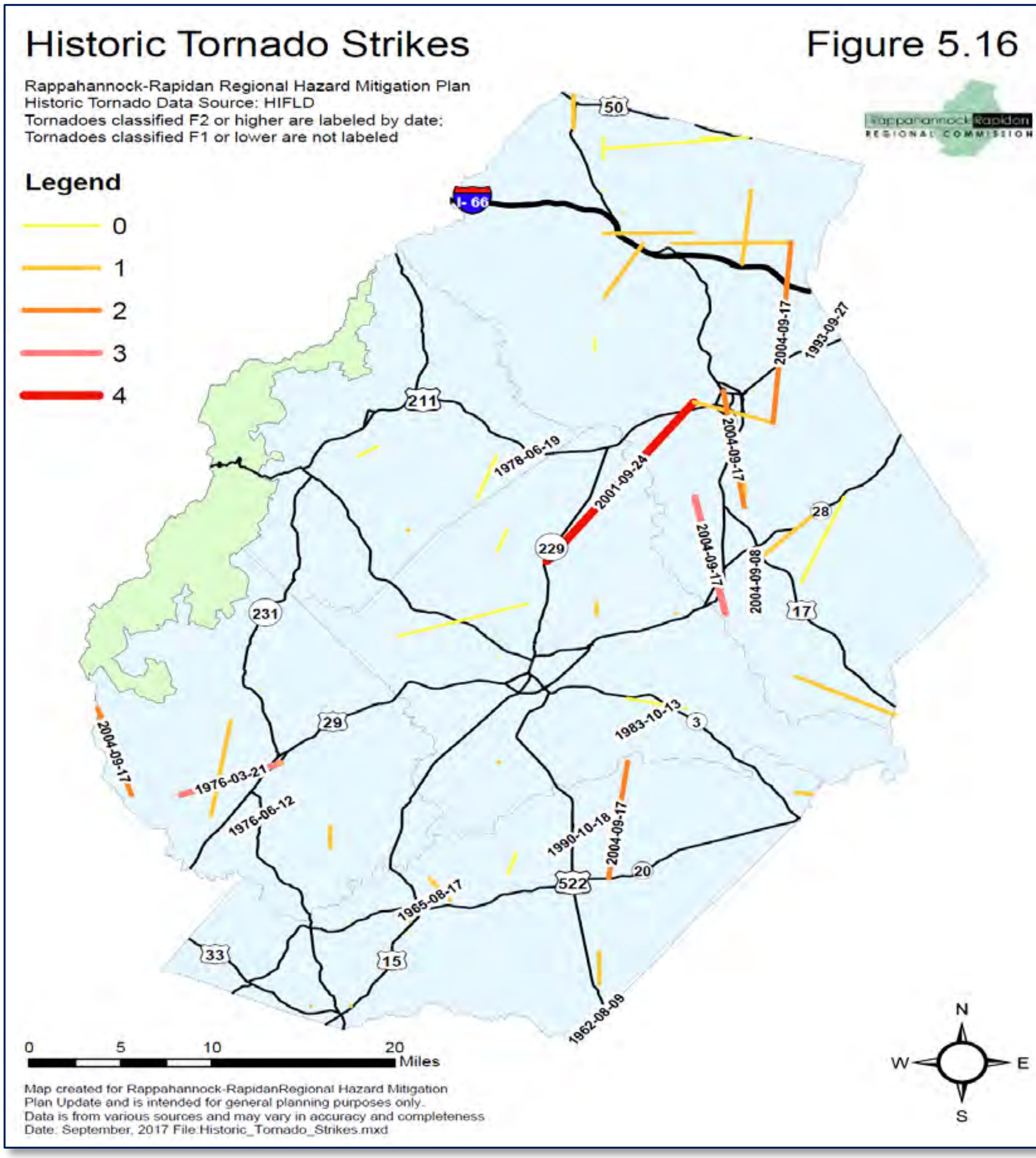


Figure 5.16 Historic Tornado Strikes illustrates where these tornado touched down in the region. The Fujita-Pearson Scale classification of each tornado is indicated for each occurrence and dates are provided for those tornadoes since 1995.

WILDFIRES

According to the Virginia Department of Forestry (VDOF), there were 615 recorded wildfires in the region from 2002-2016. Almost 50% were caused by debris burning. Other causes include equipment use, unattended campfires, unsupervised children, smoking and lightning. No deaths or injuries were recorded as resulting from these fires. 1,453 Total acres were damaged. These figures reflect the growing risk of loss due to the intrusion of the built environment into the region's forests – the expansion of the wildland – urban interface. The VDOF's wildfire risk assessment, conducted on a county-by-county level, examines six variables:

- Historic occurrence of wildfires in the area;
- Population density;
- Slope;
- Aspect;
- Land cover; and
- Distance from roads.

Variables are weighted according to their applicability to the region evaluated. Structures surrounded by or adjacent to wildland fuels, in areas historically prone to wildfires, and on steep slopes are at a greater risk than those in areas with limited fuels, a low fire occurrence rate and relatively flat terrain. Data incorporated into the risk assessment model was used to:

Figure 5.17, 1995-2015

- Identify areas favorable to wildfire development and advancement;
- Examine the spatial relationship between high risk areas and woodland home communities, fire stations and fire hydrants;
- Identify areas requiring more detailed analysis.

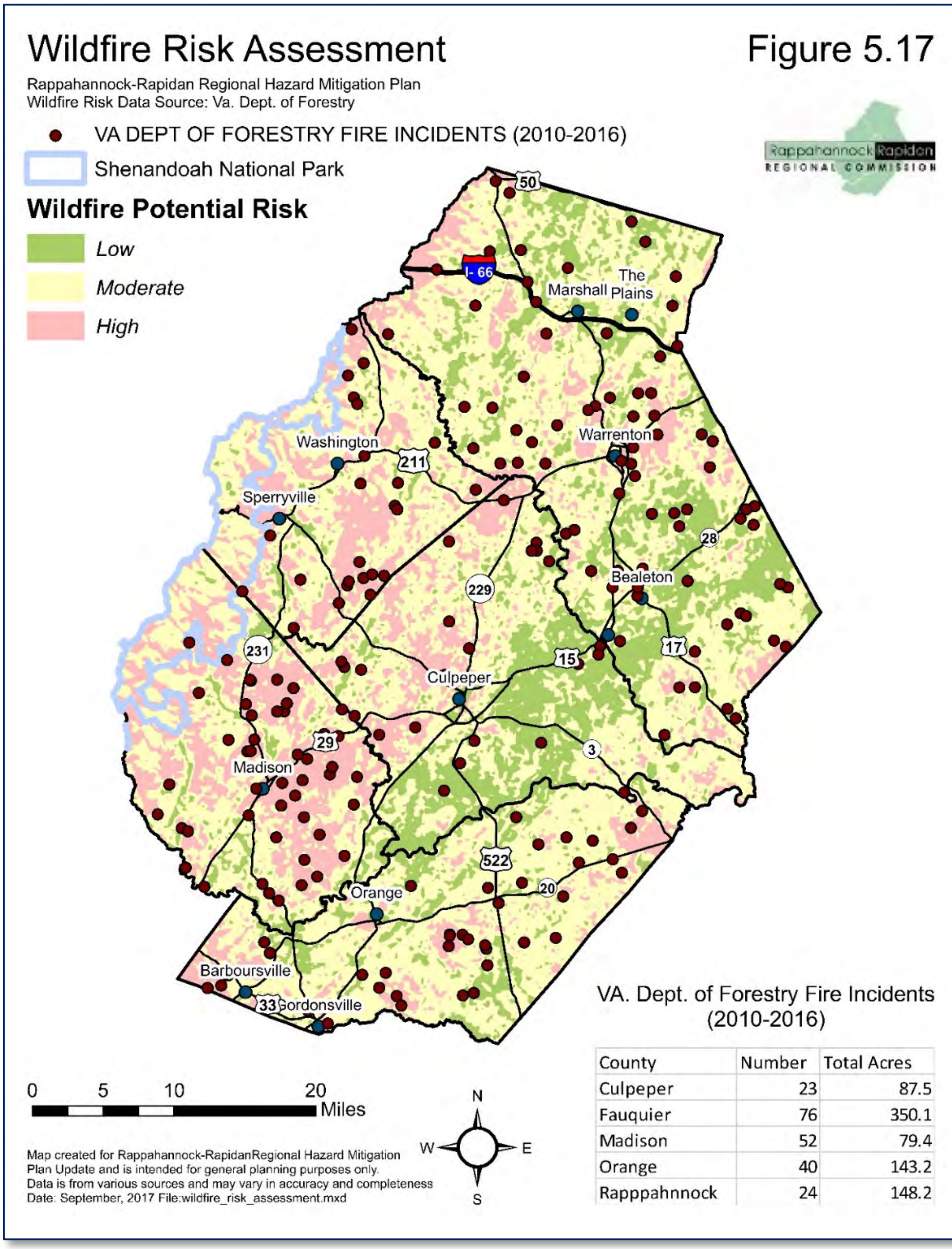


Figure 5.17 shows the Wildfire Risk Assessment in the region, according to the Virginia Department of Forestry. Within the Rappahannock-Rapidan region, Rappahannock and Madison counties are at greatest risk for wildfires. With heavily forested slopes marking their western boundaries, their proximity to the forests of Shenandoah National Park and relatively steep terrain, the two counties incorporate a number of factors that make them particularly vulnerable. In 2002, both counties shared the impacts of a huge wildfire, most of which was confined to Shenandoah National Park, that burned over 24,800 acres. Although the damage to forested areas in Rappahannock and Madison was minimal compared with that documented in the park, the conditions that generated the blaze and contributed to its movement were present in both counties. Rapid, efficient and effective response by local firefighters and park personnel limited the movement of the blaze outside of the park.

Table 5.8 Wildfires, 2002-2016

County	Events	Acres Impacted	County	Events	Acres Impacted
Culpeper	110	247.6	Orange	143	214.4
Fauquier	145	460.8	Rappahannock	70	229.9
Madison	147	300.5	**REGIONAL TOTALS:**	**615**	**1,453.20**

Source: *Virginia Department of Forestry*

Table 5.9 Wildfires Incidents Per Risk Areas, 2002-2016

County	Events	# of Incidents in High Risk Area (2002-2016)	# of Incidents in Moderate Risk Area (2002-2016)	# of Incidents in Low Risk Area (2002-2016)
Culpeper	110	28	60	22
Fauquier	145	27	87	31
Madison	147	90	51	6
Orange	143	32	97	14
Rappahannock	70	30	39	1
REGIONAL TOTALS:	**615**	**207**	**334**	**75**

Source: *Virginia Department of Forestry*

DROUGHT

Since 1995, there have been several periods of drought recorded in the Rappahannock-Rapidan region. The National Climatic Data Center attributes nearly $31 million in crop loss to these events. Drought events usually impact all the localities in the region simultaneously. Although drought events are difficult to predict, each of the localities' water supply plans are currently in compliance with the 9VAC25-780 regulation requiring all counties, cities and towns in the Commonwealth of Virginia to submit a local water supply plan. The water supply plan requires detailed drought response and contingency plans in the event of drought conditions.

Table 5.10 Drought, 1995-2015

Location	Number of Events	Dates	Crop Damage*
Culpeper County	11	8/1/1998, 11/1/1998, 12/1/1998, 5/1/1999, 6/1/1999, 7/1/1999, 8/1/1999, 9/1/1999, 7/24/07, 8/1/07, 10/1/07	5.2M
Fauquier County	12	7/1/1997, 8/1/1998, 11/1/1998, 12/1/1998, 5/1/1999, 6/1/1999, 7/1/1999, 8/1/1999, 9/1/1999, 7/24/2007, 8/1/2007, 10/1/2007	8.0M
Madison County	11	8/1/1998, 11/1/1998, 12/1/1998, 5/1/1999, 6/1/1999, 7/1/1999, 8/1/1999, 9/1/1999, 7/24/07, 8/1/2007, 10/1/2007	4.0M
Orange County	11	8/1/1998, 11/1/1998, 12/1/1998, 5/1/1999, 6/1/1999, 7/1/1999, 8/1/1999, 9/1/1999, 7/24/07, 8/1/2007, 10/1/2007	10.0M
Rappahannock County	11	7/1/1997, 8/1/1998, 11/1/1998, 12/1/1998, 5/1/1999, 6/1/1999, 7/1/1999, 8/1/1999, 9/1/1999, 8/1/2007, 10/1/2007	3.5M
Regional Totals	**56**	**13 Drought Events**	**30.7M**

Source: *National Climatic Data Center, NCDC Events include Drought*

During the summer of 2002 Virginia experienced a significant drought resulting from the cumulative impacts of three years of precipitation deficits. While this drought did not reach the level of severity of the drought of record (1930-1932), increased water demands, as compared with those of the 1930s, resulted in substantial impacts to the Commonwealth and its economy.

The intensity of the drought peaked in late August, 2002. Wildfire indices were at levels previously unrecorded in Virginia, the majority of agricultural counties had applied for Federal drought disaster designation, stream flows were at record lows, and thousands of individual private wells failed.

During the third week of August, several public water supply systems across the state were on the brink of failure. Several large municipal systems had fewer than sixty days of water-supply capacity remaining in reservoirs, while some smaller rural systems that rely primarily on withdrawals from free-flowing streams, such as the town of Orange, had only a few days' supply available.

On August 30, 2002 Governor Warner took the unprecedented action of declaring a drought emergency and issued Executive Order #33, requiring the elimination of non-essential water use in large areas of the Commonwealth and naming the Deputy Secretary of Natural Resources as the Commonwealth Drought Coordinator. Executive Order #39, the Virginia Water Supply Initiative, followed on December 13, 2009.

This required the development of the Commonwealth's Drought Response Technical Advisory Committee, charged with the development of a water supply, drought monitoring and response plan (www.deq.virginia.gov).

EXTREME HEAT

Because human response to heat depends on the interaction of multiple meteorological variables including temperature, humidity, cloud cover and regional experience, extreme heat criteria and designation are not absolute. Generally, an extreme heat event is characterized by a prolonged period of temperatures 10 degrees or more above the average high temperature accompanied by high humidity. Localities are equally susceptible to extreme heat events. Climate change and other factors may increase the likelihood of extreme heat events in the region over the next century.

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Table 5.11
Temperature Caution Index

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution   Extreme Caution   Danger   Extreme Danger

Table 5.11 Extreme Heat Events, 1995-2015

Location	Number of Events
Culpeper County	4
Fauquier County	4
Madison County	3
Orange County	3
Rappahannock County	2
Regional Totals:	**16**

Source: *National Climatic Data Center, NCDC Events include Excessive Heat*

EARTHQUAKES

According to the Virginia Department of Mines, Minerals and Energy, earthquake activity in Virginia has been low-magnitude but persistent. The first documented earthquake in Virginia took place in 1774 near Petersburg. Many others have occurred since then, including an estimated magnitude 5.9 (VII) event in 1897 centered near Pearisburg in Giles County. This was the second largest earthquake in the eastern U.S. It was felt across twelve states, an area of at least 280,000 square miles. Since 1977, when Virginia Tech expanded its seismograph array, more than 175 quakes have been detected as originating beneath Virginia. Of these, at least twenty-eight were large enough to be felt at the surface. Thus, Virginia averages about six earthquakes per year, of which one is felt at the surface.

Virginia's past seismic activity has been concentrated in two areas: the central Piedmont along the James River, and the New River Valley in Giles County (see Fig. 5.17). Since all parts of the Commonwealth have experienced seismic activity in the past, the entire state should be considered susceptible to earthquakes. The Rappahannock-Rapidan region lies to the north of Virginia's identified seismic belts; however, the effects of earthquakes are often experienced at great distances from their epicenters. The large earthquakes that occurred in New Madrid, Missouri in 1811 and 1812, and the Charleston, S.C. quake of 1886, were all strongly felt in the region.

Most recently, on August 23, 2011, a magnitude 5.8 earthquake centered near Mineral, Virginia (about 15 miles south of the Rappahannock-Rapidan region) caused damage to the Rappahannock-Rapidan region. In the region, damages were most evident in the town of Culpeper, where one building was destroyed and several were condemned. No critical infrastructure was rendered unusable.

In the Rappahannock-Rapidan region, Culpeper County was designated for Public Assistance (Assistance to State and local governments and certain private non-profit organizations for emergency work and the repair or replacement of disaster-damaged facilities) by FEMA. According to FEMA data, more than $675,000 in public assistance was provided to local government or eligible non-profit organizations in response to the earthquake. Individual Assistance (assistance to individuals and households) designations were provided by FEMA for Culpeper and Orange counties. Individual assistance provided, according to FEMA data, totaled $462,299 for Culpeper County and $662,041 for Orange County.

Figure 5.18 Seismic Zones in Virginia

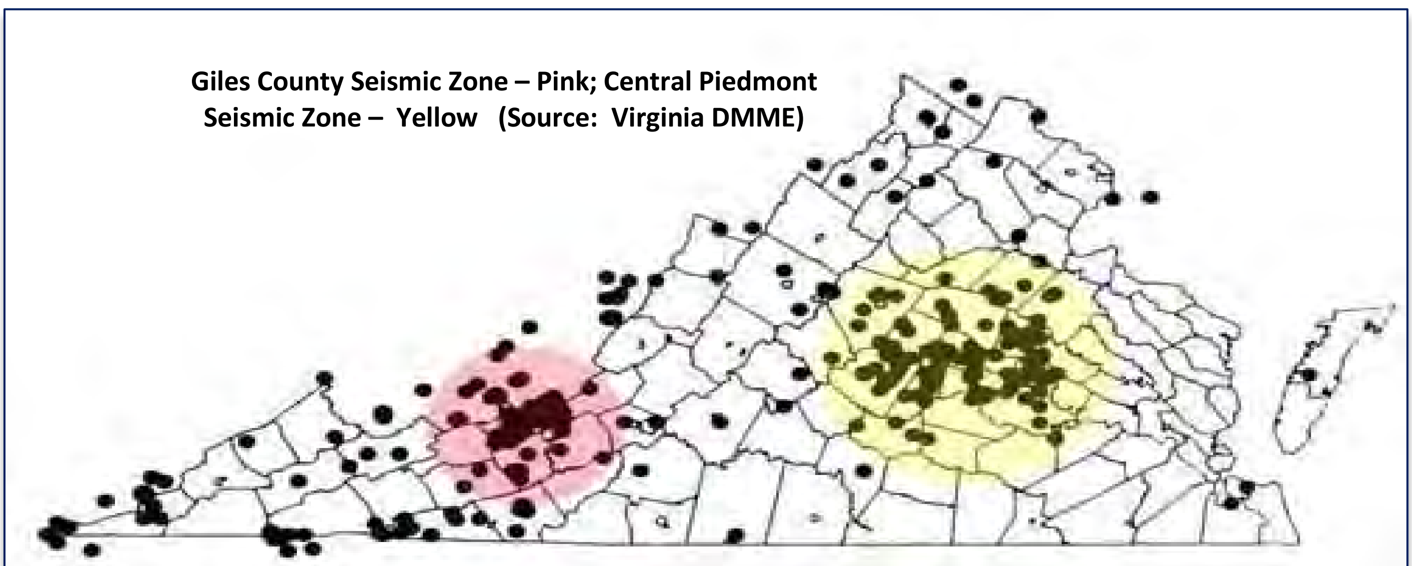
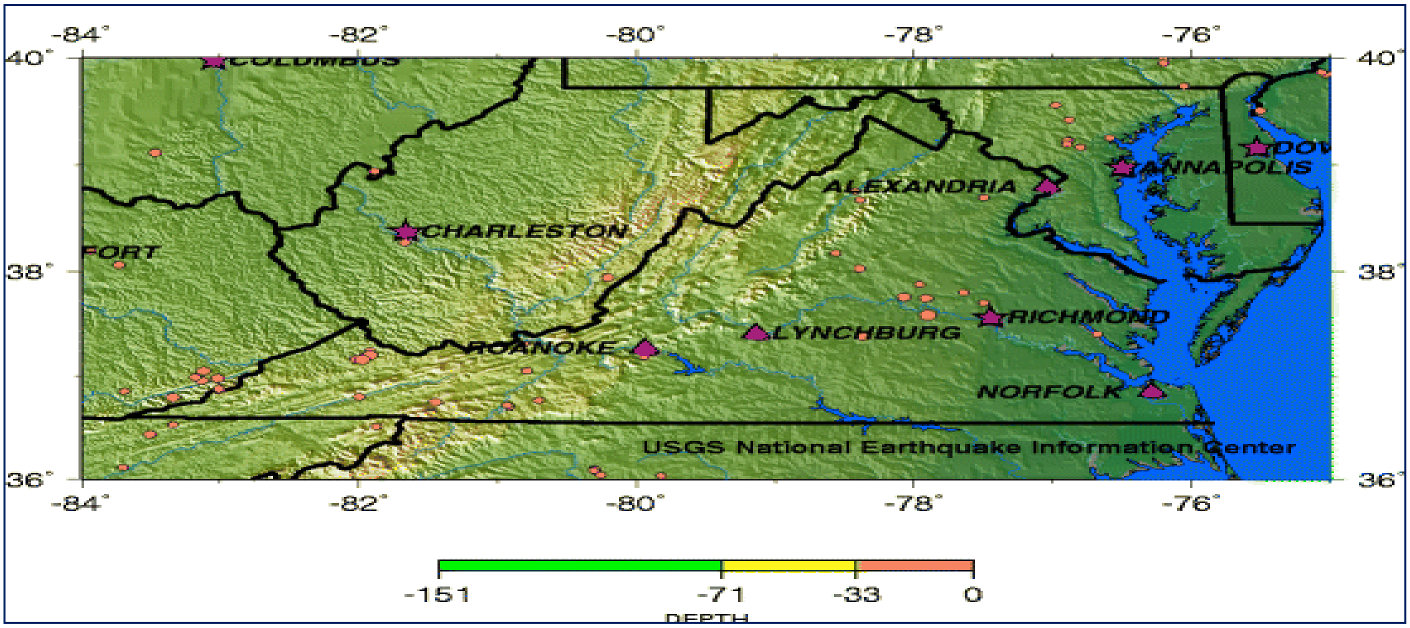


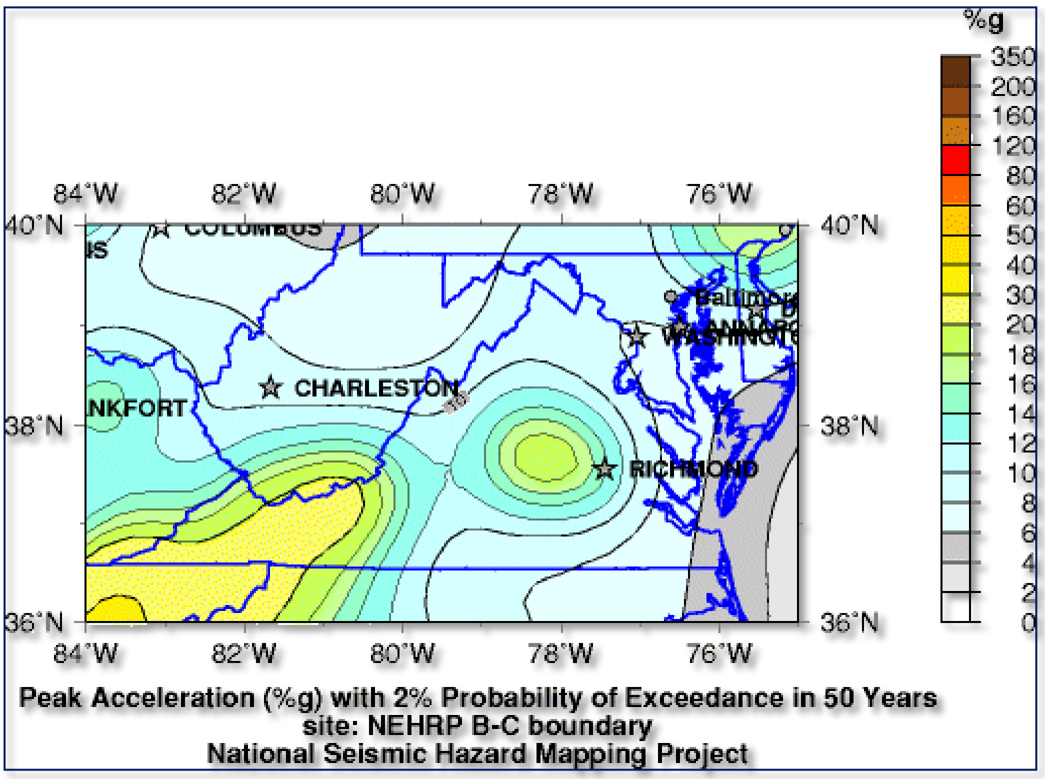
Figure 5.19 Seismicity of Virginia, 1990-2006



***Source**: USGS, Circles=Earthquakes (Depth in KM indicated by color)*

Figure 5.20 summarizes the expected earthquake intensity levels with 10 percent probability of exceedance in 50 years based on the national U.S. Geological Survey map of peak acceleration.

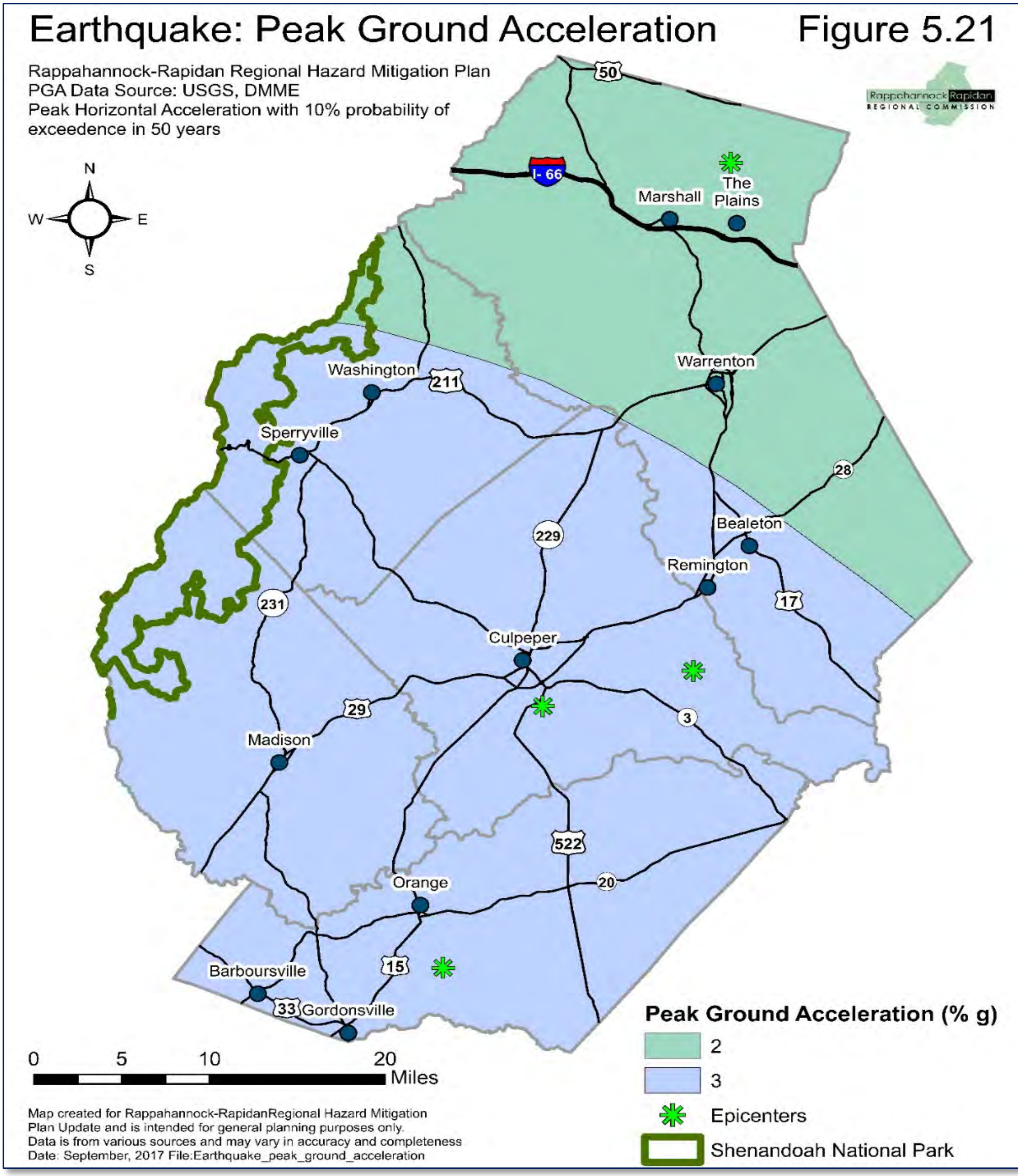
Figure 5.20 Geological and Seismic Information for Virginia



As mapped, the greater part of the region sits within a zone of 3 percent peak ground acceleration with a very small area in a zone of 2 percent peak ground acceleration. Thus the region, as a whole, is in an area of relatively limited seismic risk.

***Source**: USGS, National Seismic Hazard Mapping Project*

Figure 5.21 Earthquake Peak Ground Acceleration



The entire Commonwealth is subject to earthquake activity; however, western and central regions are most vulnerable to potential damage. The following list of earthquake events that have occurred in the Rappahannock-Rapidan region since 1875 has been compiled from National Geophysical Data Center records

(Table 5.12). Future seismic events are likely to impact the region at historic frequencies with at least one event every thirty years

Table 5.12 Significant Seismic Events Impacting the Region, 1774-2015

Date	Location Recording Occurrence	Distance from Epicenter (Miles)	Modified Mercalli Intensity
1/3/1885	Warrenton	59	Unknown
9/1/1886	Madison	634	Unknown
4/10/1918	Orange	58	Unknown
1/6/1935	Culpeper	924	Unknown
5/311966	Culpeper	101	3.1
11/20/1969	Culpeper	296	4.3
9/5/1972	Montpelier	24	3.3
7/30/1981	Orange	8	1.4
5/6/1982	Montpelier	10	2.0
8/7/1984	Gordonsville	30	4.2
8/23/2011	Culpeper	36	5.8

***Source**: National Geophysical Data Center*

LAND SUBSIDENCE (KARST AND/OR SINKHOLES)

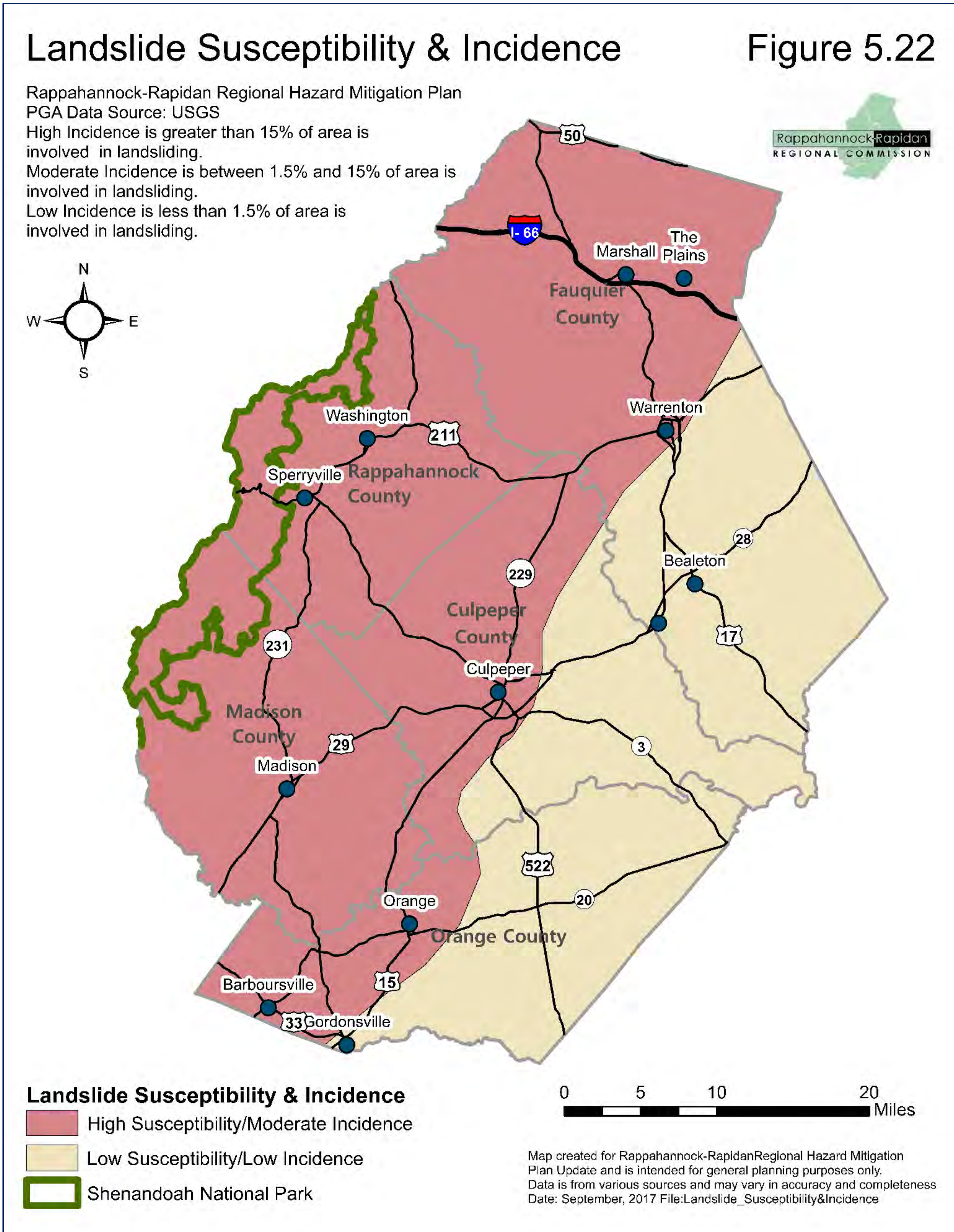
Sinkholes are common in areas characterized by soluble bedrock including limestone or other carbonates, salt deposits or any rock that can be dissolved naturally by circulating ground water. The geology of the Rappahannock-Rapidan region limits the likelihood of sinkhole development; however, subsidence events associated with the decay of buried construction debris or woody material from land-clearing activities, as well as slumping resulting from leaking underground water lines, do occur. Due to the rarity of true sinkhole development in the region, no data on their occurrence has been compiled, nor maps generated. No information regarding the probability of sinkhole development could be found for the region.

LANDSLIDES

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, particularly where septic systems are used. Research has revealed that about fifty-six percent of recent landslides occurred on slopes that had been altered in some way by development.
Because of the prevalence of steep slopes, numerous streams, shallow soils and other contributing factors, the western portions of Fauquier, Rappahannock, and Madison counties are particularly vulnerable to landslides. Overall, according to the U.S. Geological Survey, the region is split between a zone of high susceptibility/moderate incidence and low incidence (Figure 5.21).

***On June 27, 1995, an intense storm dumped approximately 30 inches of rain on Madison County in a period of 16 hours. This resulted in hundreds of debris flows in the Graves Mill area of the county and the area was declared a disaster area by the Federal Emergency Management Agency.**

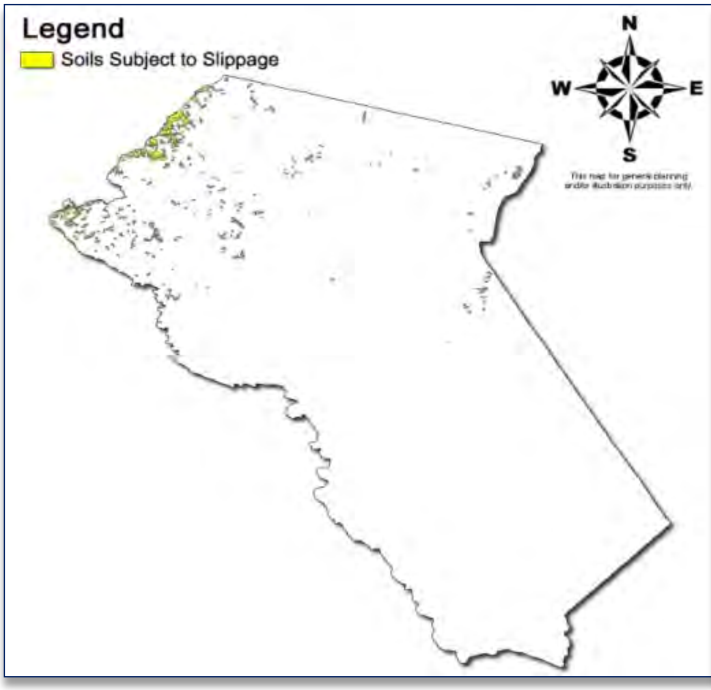
Figure 5.22 Landslide Susceptibility & Incidence

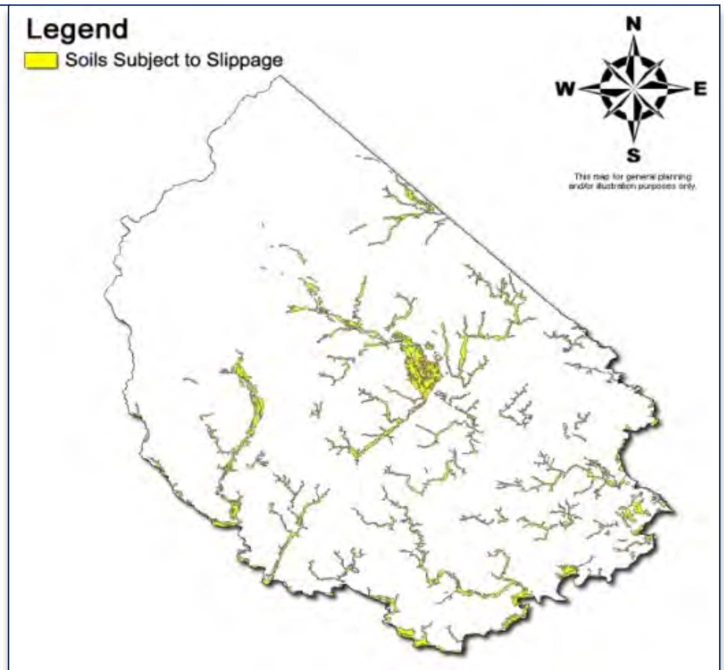


EROSION

Unless one considers landslides to be part of this process, there have been no erosion events of historic magnitude or significance in the Rappahannock-Rapidan region. Erosion is an everyday occurrence, an ongoing process that continually alters Earth's surface. The region's steep slopes, numerous streams, exposed farmland and un-stabilized building sites are areas where erosion commonly occurs; however, government agencies at the local, state and federal levels, as well as educational institutions, work diligently to inform the citizenry of the importance of erosion control and the management practices that may be implemented to address it.

Figure 5.23 Vulnerable Soils for Fauquier and Madison Counties





On June 27, 1995, an intense storm dumped approximately 30 inches of rain on Madison County in a period of 16 hours. This resulted in hundreds of debris flows in the Graves Mill area of the county and the area was declared a disaster area by the Federal Emergency Management Agency. Figure 6.7 (in the *Vulnerability Assessment* section) shows the area impacted by this event.

DAM FAILURE

Dam failure includes the collapse, overtopping, breaching or other events that result in the uncontrolled release of water or sludge from an impoundment with subsequent downstream flooding. Dam failures may occur with little warning. They may result from the effects of intense storms, debris jams or sudden snow melt.

Dam failure may result from any one or combination of the following:

- Prolonged periods of rainfall and flooding;
- Inadequate spillway capacity;
- Internal structural erosion;
- Improper maintenance;
- Intentional criminal acts.
- Negligent operation;
- Failure of upstream structure(s);
- High winds creating erosion by wave action;
- Improper design, material selection; and/or construction;

Virginia's recent (2017) revisions to its dam classification and regulatory system bring it into alignment with that used in the National Inventory of Dams maintained by the U.S. Army Corps of Engineers. Hazard potential is directly related to anticipated adverse downstream impacts should the given dam fail. The owner of each regulated dam, whether high, significant or low hazard, is required to obtain an Operation and Maintenance Certificate. This must include an assessment of the dam by a licensed professional and an Emergency Action Plan which must be filed with the appropriate local emergency official and the Virginia Department of Emergency Management. Certification types within the region include MR for regular operation and maintenance and MC indicating conditional certification. OC classification indicates ongoing evaluation for classification status. AE classification indicates an exemption due to agricultural use and size as defined under §10.1-604 of the Virginia Dam and Safety Act.

There are no comprehensive databases of historical dam failures in Virginia. The Virginia Department of Conservation and recreation is the regulatory agency responsible for maintaining dam inspection data and is currently in the process of updating certification and inspection spatial data.

According to the Virginia Department of Conservation and Recreation there are 101 state regulated dams in the Rappahannock-Rapidan region that have known hazard classifications. Of those, 14 are classified as high hazard potential, 27 are significant and 60 are low (see Figure 5.23 – Dam Classification).

Table 5.13 Virginia Dam Classification

Hazard Potential	Failure Effects	Inspection
High	Probable loss of human life, serious economic impact (buildings, facilities, major roads, etc.)	Annual, with inspection by professional engineer every 2 years.
Significant	May cause loss of human life or appreciable economic impact (buildings, secondary roads, etc.)	Annual, with inspection by professional engineer every 3 years.
Low	No expected loss of human life, no more than minimal economic impact.	Annual, with inspection by professional engineer every 6 years.

Figure 5.23 Dam Inventory & Classification

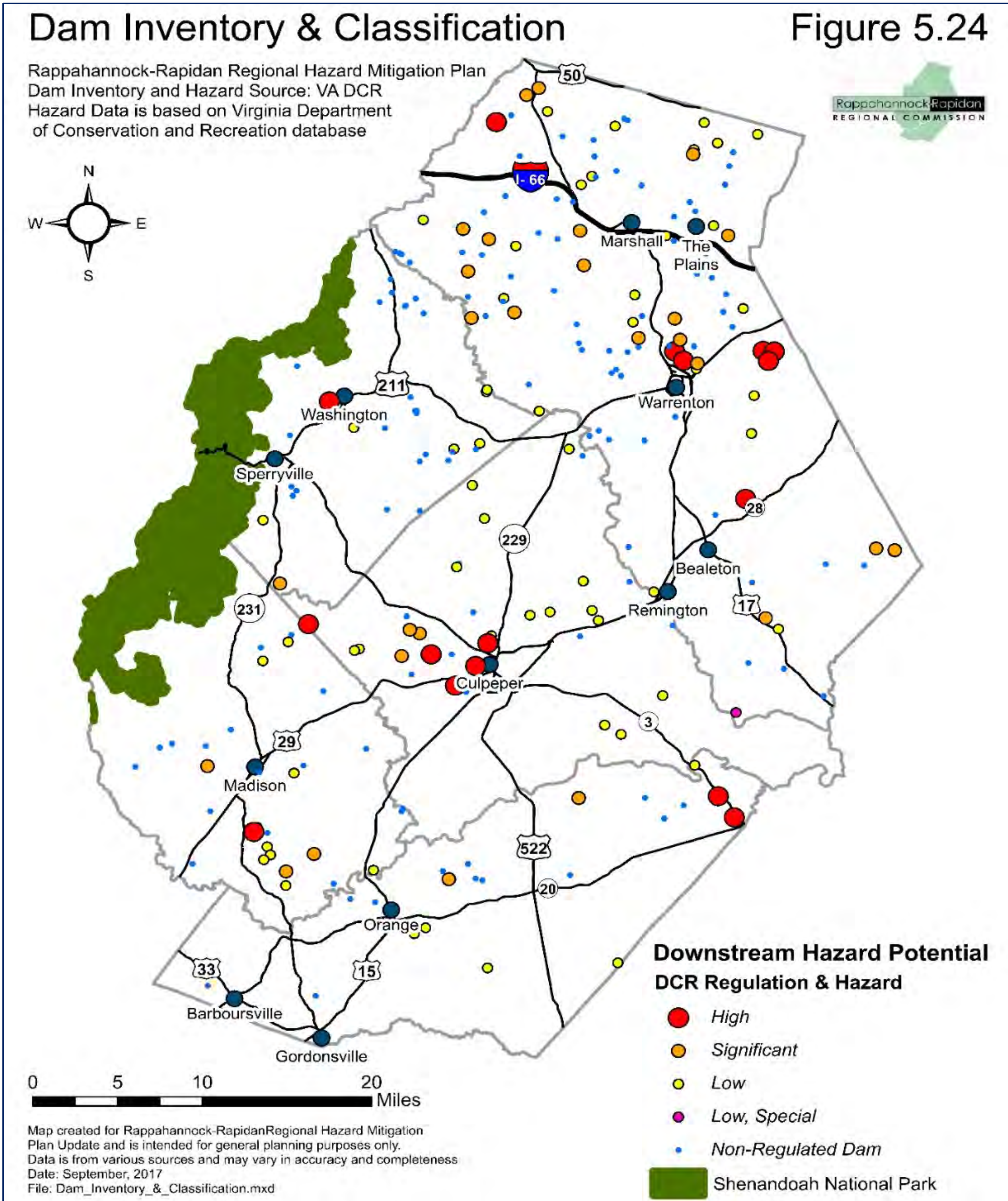


Table 5.14 Virginia Dam Classification

Location/Dam	Hazard Potential			Classification			
Culpeper	**High**	**Significant**	**Low**	**MC**	**MR**	**OC**	**AE**
Beauregard Dam No. 1			x				x
Beauregard Dam No. 2			x				x
Benzinger Dam			x			x	
Brandy Rock Farm Dam			x			x	
Cole Dam No. 1			x	x			
Compton Dam			x				x
Hawkins Dam			x				x
Hazel Lake Dam			x			x	
Lee Rillhurst Dam		x				x	
Miller Place Dam			x				x
Mountain Run 8A			x		x		
Mountain Run 11		x		x			
Mountain Run 50	x			x			
Mountain Run 13			x		x		
Mountain Run 18	x				x		
Seven Islands Dam	x					x	
Smiley-Henry			x			x	
South Wales			x		x		
Cole 1			x	x			
Troiano		x			x		
Willis Dam			x				x
Totals:	**3**	**3**	**15**	**4**	**5**	**6**	**6**
Fauquier	**High**	**Significant**	**Low**	**MC**	**MR**	**OC**	**AE**
Airlie Dam		x		x			
Ardarra Farm Dam			x			x	
Barr Dam		x		x			
Belle Vue Farms Dam			x			x	
Belvoir Farm Dam			x			x	
Big Lake Dam			x			x	
Bowmans Dam			x			x	
Brick House Dam			x			x	
Brockett Dam			x			x	
Cedar Run Dam #3	x				x		
Clifton Farm Lower Dam		x		x			
Coventry Dam		x			x		
Dalton Dam		x				x	
DiGuilian Dam		x				x	
Fleetwood Farm Dam #1			x			x	
Fleetwood Farm Dam #2		x				x	
Glascock Run Dam			x			x	
Herbert Dam			x			x	
Hickory Tree Farm Dam			x			x	
Hideaway Hills Dam		x		x			
High Mountain Farm Dam			x			x	
Johnson Dam		x				x	
Keltonic Lake Dam			x			x	
Kinloch Farm Dam		x			x		

Lake Anne Dam	x				x		
Lake Ashby Dam	x			x			
Lake Brittle Dam	x				x		
Licking Run Dam	x				x		
Lower Warrenton Lakes Dam			x		x		
Mathews Dam		x				x	
Mellott Dam		x		x			
Merry Oak Dam			x			x	
Montgomery Pond			x			x	
Pickett Dam			x			x	
Sawyer Dam		x				x	
Sherwood Dam			x			x	
Silbersiepe Dam			x			x	
Springhill Farm Dam			x	x			
Thompson Dam	x			x			
Thorn Dam			x			x	
Volgenau Dam		x			x		
Warrenton Dam	x				x		
Warrenton Lake Dam			x			x	
Waterford Farm			x			x	
Waterfowl Impoundment Dam			X		x		
Willow Dam			X			x	
Willow Pond Farm Dam		x		x			
Winslow Dam		x		x			
TOTALS:	**7**	**16**	**25**	**10**	**10**	**28**	**0**
Madison	**High**	**Significant**	**Low**	**MC**	**MR**	**OC**	**AE**
Beautiful Run 1B			x		x		
Beautiful Run 2A	x			x			
Beautiful Run 4			x		x		
Beautiful Run 5			x		x		
Beautiful Run 6			x		x		
Beautiful Run 7		x			x		
Beautiful Run 10			x		x		
Beautiful Run 11		x			x		
Deep Run Farm		x			x		
Hablutzel			x		x		
Malvern			x	x			
White Oak		x			x		
Woodberry Forrest Lake Dam			x	x			
Totals	**1**	**4**	**8**	**3**	**10**	**0**	**0**
Orange	**High**	**Significant**	**Low**	**MC**	**MR**	**OC**	**AE**
Decoursey Dam			x		x		
Grymes Mill			x		x		
Keaton's Run	x				x		
James A. Strong			x			x	
Lake of the Woods	x				x		
Lake Orange Dam			x		x		
Leeland Lake Dam		x				x	
Northrup			x		x		
Orange Raw Water Reservoir		x				x	
Spotswood Drive Dam			x	x			
Spring Vale		x		x			

Totals	2	3	6	2	6	3	0
Rappahannock	**High**	**Significant**	**Low**	**MC**	**MR**	**OC**	**AE**
Graage Dam			x			x	
Johnson Dam			x			x	
Liverman Dam			x			x	
Margolis Dam			x			x	
Mt Airy Hunt Club Dam		x				x	
Sweeny Dam			x			x	
Whippoorwill	x			x			
Totals	**1**	**1**	**5**	**1**	**0**	**6**	**0**
Region Totals:	**14**	**27**	**59**	**20**	**31**	**43**	**6**

DATA SOURCES: Section 5

American Society of Civil Engineers (ASCE), "Facts About Windstorms."
Web site: www.windhazards.org/facts.cfm

Bureau of Reclamation, **U.S. Department of the Interior**
Web site: www.usbr.gov

Federal Emergency Management Agency (FEMA), Department of Homeland Security
Web site: www.fema.gov

National Climatic Data Center (NCDC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: http://lwf.ncdc.noaa.gov/oa/ncdc.html

National Geophysical Data Center
Web site: http://www.ngdc.noaa.gov/

National Hurricane Center, National Oceanic & Atmospheric Administration (NOAA)
Web site: http://www.nhc.noaa.gov/

National Severe Storms Laboratory (NSSL), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: www.nssl.noaa.gov

National Weather Service (NWS), U.S. Department of Commerce, National Oceanic and Atmospheric Administration
Web site: www.nws.noaa.gov

Storm Prediction Center (SPC), U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service
Web site: www.spc.noaa.gov

The Tornado Project, St. Johnsbury, Vermont
Web site: www.tornadoproject.com

United States Geological Survey (USGS), U.S. Department of the Interior
Web site: www.usgs.gov

Virginia Department of Conservation and Recreation
Web site: www.dcr.virginia.gov/

The Hazard Analysis of the Rappahannock-Rapidan region has identified those hazards listed below as significant threats to the area. The potential impacts of hazards as reviewed in Section 4 and quantified in Section 5 have been assessed and grouped according to potential impact and, where appropriate, relevance to associated events. For example, the category "Winter Storms" now includes events characterized by extreme cold since the sub-category "Freezes" has been determined to be relatively insignificant. In addition, the Erosion and Landslide categories were combined, as were Sinkholes and Karst topography, given their relative historical impacts. All assessments are based on best available data.

Natural Hazards

- Flood
- Hurricanes and Tropical Storms
- Severe Thunderstorms and Tornadoes
- Wildfire
- Drought
- Winter Storms
- Earthquakes
- Land Subsidence (Karst and/or Sinkholes)
- Landslides/Erosion
- Dam Failure

Assessment Methodologies

Assessment tools used included:

- HAZUS®MH MR4;
- GIS (Non-HAZUS) Risk Assessment; and
- Qualitative Review by Steering Committee

44CFR Requirement

44 CFR Part 201.6(c)(2)(ii): The risk assessment shall include a description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. The description shall include an overall summary of each hazard and its impact on the community. The plan should describe vulnerability in terms of: (A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; (B) An estimate of the potential losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate; (C) Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

HAZUS®MH, a geographic information loss estimation software tool, available through the Federal Emergency Management Agency, was partnered with regional and local GIS analysis to provide a quantitative assessment of potential hazards. Qualitative information was derived from data provided by members of the Advisory Committee who assigned values to the likelihood of occurrence, spatial extent and potential of each hazard studied.

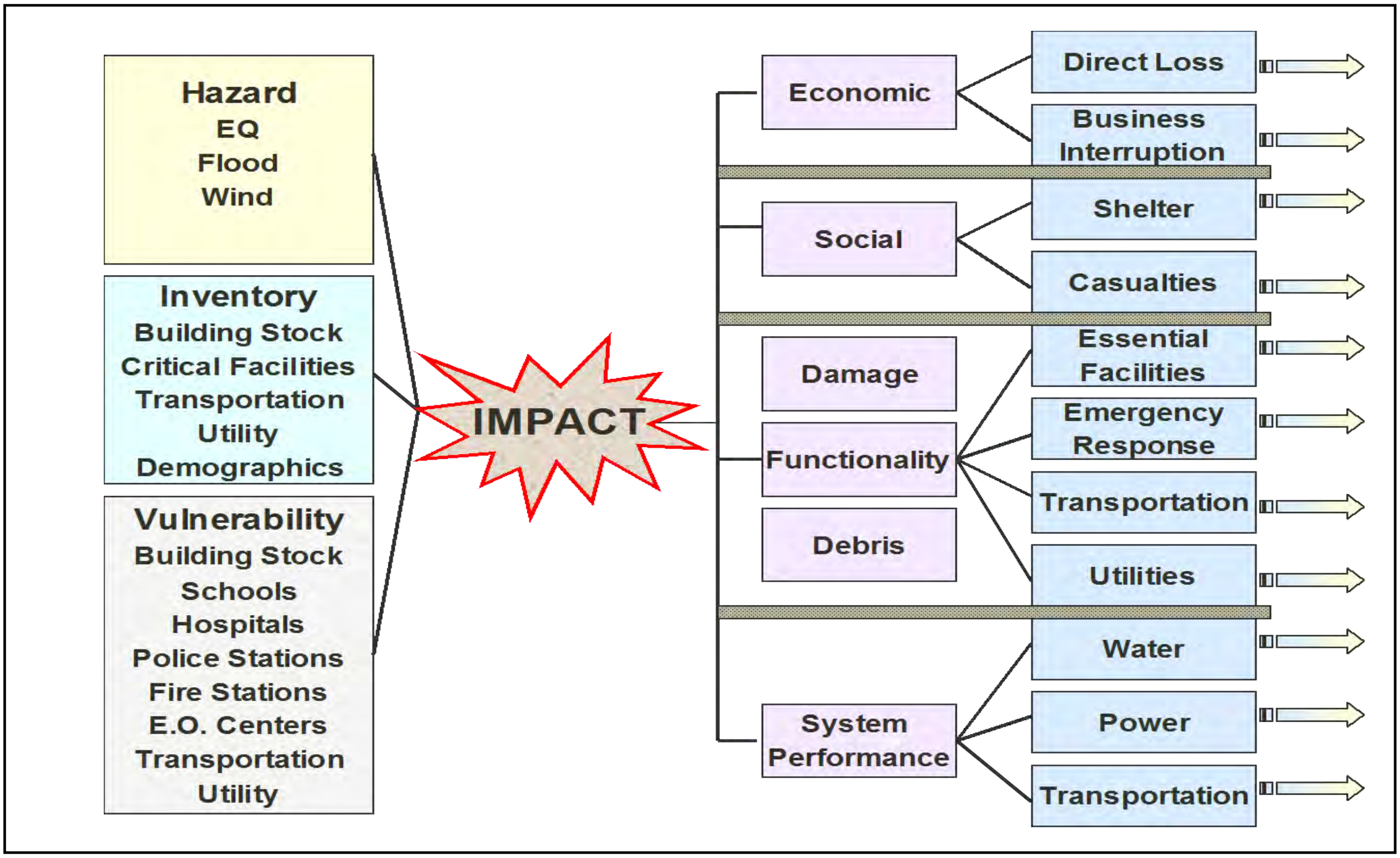
It should be noted that the vulnerability determinations presented in this section are based on best available data and represent an approximation of risk. While useful in understanding relative risk and potential loss, all such analyses include inherent uncertainty reflecting incomplete knowledge and the approximations and simplifications that are an integral part of any loss estimation methodology.

HAZUS^{MH} Risk Assessment Methodology

HAZUS^{MH} is FEMA's nationwide standardized loss estimation software package, built on an integrated GIS platform. In this risk assessment, HAZUS^{MH} MR4 was used to produce regional profiles and estimated losses for three of the hazards addressed in this section: flood, hurricane winds and earthquake.

The HAZUS^{MH} risk assessment methodology is parametric, in that distinct hazard and inventory parameters—such as wind speed and building type, for example—were modeled using the HAZUS^{MH} software to determine the impact (damages and losses) on the built environment. Figure 6.1 shows a conceptual model of HAZUS^{MH} methodology.

Figure 6.1 Conceptual Model of HAZUS Methodology



It is important to note that for those hazards where HAZUSMH MR4 was used, "worst case scenario" results were produced to show the maximum potential extent of damages for those hazards. It is understood that any smaller events that could occur would likely create lesser losses than those calculated here.

Staff conducted model runs for Flood, Earthquake, and Hurricane winds in October and November 2017. The base HAZUS data was used for the model runs due to inconsistent data across the region's jurisdictions.

Explanation of GIS-based (Non-HAZUS MH) Risk Assessment Methodology

The general steps used in the GIS-based assessment conducted independently of the HAZUSMH software are summarized below:

In addition to the HAZUSMH MR4 analysis for the region's flood vulnerability, a spatial analysis utilizing ESRI ArcGIS 10.5.1 was completed. GIS data was collected from local, state and national sources for this analysis. Floodplain data obtained from FEMA was used in combination with local GIS data layers, including tax parcel databases, structure footprints and digital orthophotography. The flood risk was assessed by calculating assessed improvement values of structures and parcels located in identified flood hazard areas. Results are detailed in the flood vulnerability section below.

For the severe thunderstorm, tornado, winter storm, drought and wildfire hazards, best available data on historical hazard occurrences (limited to NOAA National Climatic Data Center records and Virginia Department of Forestry data for wildfire) was used to produce an annualized loss estimate of potential damages. Using this data, annualized loss estimates were generated by totaling the amount of property damage over the period of time for which records were available, and calculating the average annual loss. GIS was used to show the correlations between potential future events and residential population distribution throughout the county. In instances where multiple counties are affected and the value for property damage reflects the total for the affected area, professional judgment was used in extracting a reasonable share for each county in the Rappahannock-Rapidan Region to produce an annualized loss estimate of potential damages in the Rappahannock-Rapidan Region.

For the erosion and dam/levee failure hazards, meaningful historical data (meaning data which would have included property damages and other essential indicators) was virtually non-existent, and therefore annualized potential losses for these hazards is assumed to be negligible.

Explanation of Hybrid Approach

As described in the preceding sections, the quantitative assessment focuses on potential loss estimates, while the qualitative assessment is comprised of a scoring system built around values assigned by the Mitigation Advisory Committee to the likelihood of occurrence, spatial extent and potential impact of each hazard presented here. For likelihood of occurrence, the following four options were available to members of the Mitigation Advisory Committee: Highly Likely, Likely, Possible or Unlikely. For spatial extent, three options were offered to describe the area which might be expected to be affected: Large, Moderate or Small. For potential impact, the choices consisted of: Catastrophic, Critical, Limited or Minor. Table 6.1 provides the criteria associated with each label.

Table 6.1 Criteria for Qualitative Assessment

	Assigned Value	Definition
Likelihood of Occurrence		
Highly Likely	3	Near 100% annual probability
Likely	2	Between 10 and 100% annual probability
Possible	1	Between 1 and 10% annual probability
Unlikely	0	Less than 1% annual probability
Spatial Extent		
Large	3	More than 50% of area affected
Moderate	2	Between 10 and 50% of area affected
Small	1	Less than 10% of area affected
Potential Impact		
Catastrophic	4	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of facilities for 30 days or more.
Critical	3	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than one week.
Limited	2	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than one day.
Minor	1	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of facilities.

The values assigned for each option chosen are added together for each hazard to arrive at a total score. For example, in the Rappahannock-Rapidan Region flood is considered Highly Likely (3), with a Moderate reach (2), with a Critical potential impact (3). This gives the flood hazard a total hazard rating of 8 (10 being the highest possible score.) This presents the flood hazard as the highest ranking hazard for the planning area.

All conclusions are presented in "Conclusions on Hazard Risk" at the end of this section. Findings for each hazard are detailed in the hazard-by-hazard vulnerability assessment that follows, beginning with an overview of the planning area.

OVERVIEW OF VULNERABILITY IN THE REGION

According to the U.S. Census Bureau, in 2017 the population of the Rappahannock-Rapidan Region was 177,418, a 31.6% increase from 2000. Virginia's population in 2017 was 8,470,020, having increased by 19.6% since 2000 when it was 7,079,048. The average number of persons per square mile in the Rappahannock-Rapidan region in 2010 was 91 (Fig. 6.2 – Population Density), an increase of 19 persons per square mile from 72 per square mile in 2000.

The total dollar exposure of buildings within the Rappahannock-Rapidan Region is estimated to be $22,426,422,000. This is based on HAZUS^{MH} MR4 inventories of 69,481 residential, commercial, industrial and other buildings located within the region. Total dollar exposure accounts for both the building and its contents, which is based on a percentage of the building's value. Approximately 92.11% of the buildings (and 84.53% of the building value) are associated with residential housing. Figures 6.3 through 6.5 show the distribution of residential, commercial and industrial property exposure throughout the county by census tract.

Development Trends

A general analysis of current land uses and development trends is essential in formulating mitigation options that influence future land use decisions. As was noted previously (Section 3), although the region remains primarily rural, it has experienced a 23 percent increase in population over the last 10 years. Most of this growth has occurred in localities closest to Washington, D.C. – Fauquier and Culpeper counties – and along major transportation routes.

Critical Facilities

The Rappahannock-Rapidan region's critical facilities are listed below (Table 6.2). Included is information listed in the HAZUS database along with edits provided by representatives of participating localities. Figure 6.6 is a visual display of the data included in HAZUS,

Table 6.2 Critical Facilities in the Rappahannock-Rapidan Region (HAZUS Inventory and Local Input)

County	Jurisdiction	Facility Name	Facility Type
Culpeper	Culpeper	Culpeper Regional Hospital	Hospital
Culpeper	Elkwood	Culpeper Regional Airport	Airport
Culpeper	Culpeper	Culpeper EMS Building	Emergency Coordination
Culpeper	Culpeper	Culpeper Emergency Operations Center	Emergency Operations

Culpeper	Culpeper	Reva Volunteer Fire & Rescue	Fire Station
County	**Jurisdiction**	**Facility Name**	**Facility Type**
Culpeper	Lignum	Alice C Tyler Village of Children	School
Culpeper	Culpeper	Epiphany Catholic School	School
Culpeper	Culpeper	G.W. Carver-Pied. Tec Ed Center	School
Culpeper	Culpeper	Central VA Regional Program	School
Culpeper	Culpeper	A. G. Richardson Elementary	School
Culpeper	Culpeper	Culpeper County High	School
Culpeper	Culpeper	Culpeper County Middle	School
Culpeper	Culpeper	Farmington Elementary	School
Culpeper	Culpeper	Pearl Sample Elementary	School
Culpeper	Culpeper	Sycamore Park Elementary	School
Culpeper	Brandy Station	Brandy Volunteer Fire Dept	Fire Station
Culpeper	Culpeper	Salem Volunteer Fire & Rescue	Fire Station
Culpeper	Culpeper	Culpeper County Sheriff's Office	Police Station
Culpeper	Culpeper	Culpeper Police Dept	Police Station
Culpeper	Culpeper	Culpeper Christian School	School
Culpeper	Culpeper	Emerald Hill Elementary	School
Culpeper	Culpeper	SWIFT	Financial Security
Culpeper	Culpeper	Town Water Pollution Control Facility	Water Utility
Culpeper	Culpeper	Town Water Treatment Plant	Water Utility
Culpeper	Culpeper	Town Light & Power	Electric Utility

Culpeper	Culpeper	Town Operations Center	Public Works and Environmental Services
Culpeper	Culpeper	Equinix Facility	Communications
County	**Jurisdiction**	**Facility Name**	**Facility Type**
Culpeper	Culpeper	Germanna Community College	College
Culpeper	Culpeper	Eastern View High School	School
Culpeper	Culpeper	Yowell Elementary School	School
Fauquier	Warrenton	Fauquier Hospital	Hospital
Fauquier	Midland	Fauquier-Warrenton Airport	Airport
Fauquier	Warrenton	DFREM Offices	Emergency Management
Fauquier	Bealeton	Lois Volunteer Fire Dept	Fire Department
Fauquier	Orlean	Orlean Volunteer Fire Dept	Fire Department
Fauquier	Goldvein	Goldvein Volunteer Fire Dept	Fire Department
Fauquier	Broad Run	New Baltimore VFC and Rescue	Fire & Rescue
Fauquier	Catlett	Cedar Run Volunteer Rescue Squad	Fire Department
Fauquier	Warrenton	Warrenton VFC	Fire Department
Fauquier	Remington	Remington VFC and Rescue	Fire & Rescue
Fauquier	Marshall	Marshall VFC	Fire Department
Fauquier	The Plains	The Plains VFC and Rescue	Fire & Rescue
Fauquier	Upperville	Upperville VFC	Fire Department
Fauquier	Warrenton	Warrenton Vol. Rescue Squad	Rescue Station
Fauquier	Catlett	Catlett VFC	Fire Department
Fauquier	Marshall	Marshall Vol. Rescue Squad	Rescue Station
Fauquier	Warrenton	Warrenton Police	Police Station

Fauquier	Warrenton	Sheriff's Dept-Detention Center	Police Station
Fauquier	Warrenton	Criminal Court	Public Safety
County	**Jurisdiction**	**Facility Name**	**Facility Type**
Fauquier	Warrenton	Sheriff's-Criminal Investigation	Police Station
Fauquier	Warrenton	Fauquier County Sheriff's Office	Police Station
Fauquier	Warrenton	Adult Detention Facility	Government Building
Fauquier	Warrenton	Fauquier County Courthouse (old)	Government Building
Fauquier	Warrenton	Fauquier County Courthouse (new)	Government Building
Fauquier	Multiple locations	Fauquier County Schools and Government Building	Government Building
Fauquier	Warrenton	Warren Green Administrative Building	Government Building
Fauquier	Warrenton	Parks and Recreation Gym	Government Building
Fauquier	Warreton	Warrenton-Fauquier Joint Communications Center	Government Building
Fauquier	The Plains	Wakefield School	School
Fauquier	Remington	Cornerstone Christian Academy	School
Fauquier	Midland	Midland Christian Academy	School
Fauquier	Warrenton	C. M. Bradley Elementary	School
Fauquier	Bealeton	Cedar Lee Middle	School
Fauquier	Warrenton	Fauquier High	School
Fauquier	Marshall	Marshall Middle	School
Fauquier	Catlett	H. M. Pearson Elementary	School
Fauquier	Warrenton	P. B. Smith Elementary	School
Fauquier	Remington	Margaret M. Pierce Elementary	School
Fauquier	Warrenton	W. C. Taylor Middle	School

Fauquier	Marshall	W. G. Coleman Elementary	School
Fauquier	Warrenton	Warrenton Middle School	School
County	**Jurisdiction**	**Facility Name**	**Facility Type**
Fauquier	Bealeton	Liberty High (Shelter)	School
Fauquier	Bealeton	Mary Walter Elementary	School
Fauquier	Bealeton	Grace Miller Elementary	School
Fauquier	New Baltimore	C. Hunter Ritchie Elementary	School
Fauquier	New Baltimore	Kettle Run High School	School
Fauquier	New Baltimore	Greenville Elementary School	School
Fauquier	New Baltimore	Auburn Middle School (Shelter)	School
Fauquier	Warrenton	Brumfield Elementary	School
Fauquier	Marshall	Claude Thompson Elementary	School
Fauquier	Remington	M.M. Pierce Elementary	School
Fauquier	Midland	Southeastern Alternative School	School
Fauquier	Middleburg	Montessori School of Middleburg	School
Fauquier		Mountainside Montessori	School
Fauquier		Lois Atkins Head Start	School
Fauquier	Multiple locations	Fauquier Community Child Care	Daycare
Fauquier	Warrenton	Children of America	Daycare
Fauquier	Bealeton	Children of America	Daycare
Fauquier	Warrenton	Jack and Jill	Daycare
Fauquier		Maplewood Childcare Center	Daycare
Fauquier		Piedmont Child Development Center	Daycare

Fauquier	Bealeton	Southern Fauquier Child Development	Daycare
Fauquier	Multiple locations	Walnut Grove Childcare Facility	Daycare
County	**Jurisdiction**	**Facility Name**	**Facility Type**
Fauquier		Walnut Grove Academy	Daycare
Fauquier	Warrenton	Warrenton Baptist Tiny Tot Care Center	Daycare
Fauquier	Warrenton	Fauquier County Garage	Fuel Site
Fauquier		Morgan Oil	Fuel Site
Fauquier	Warrenton	Brookside Nursing Home	Nursing Home
Fauquier	Warrenton	Fauquier Health and Rehab Center	Nursing Home
Fauquier		America House	Nursing Home
Fauquier		The Oaks	Nursing Home
Fauquier		Moffett Manor	Nursing Home
Fauquier		Blue Ridge Christian Home	Nursing Home
Fauquier	Warrenton	Warrenton Manor	Nursing Home
Fauquier	Warrenton	Waste Water Plant	Waste Water Plant
Fauquier	Marshall	Marshall Water Plant	Water Treatment Plant
Fauquier	Remington	Remington Water Plant	Water Treatment Plant
Fauquier	Vint Hill	Vint Hill Water Plant	Water Treatment Plant
Fauquier	Warrenton	Warrenton Water Treatment Plant	Water Treatment Plant
Fauquier		Marsh Run Generation Facility	Utility
Fauquier	Remington	Remington Combustion Turbine Station	Utility
Fauquier	Bealeton	Marsh Run Mobile Home Park	Residential
Fauquier	Warrenton	Poets Walk Memory Care	Assisted Living

Fauquier	Warrenton	American Legion Assisted Living	Assisted Living
Fauquier	Warrenton	Warrenton Town Hall	Government Building
County	**Jurisdiction**	**Facility Name**	**Facility Type**
Fauquier	Warrenton	Highland School	School
Fauquier	Warrenton	Meadowbrook Child Development	Day Care
Fauquier	Warrenton	St. James Episcopal School	School
Fauquier	Warrenton	St. John the Evangelist School	School
Fauquier	Warrenton	Boxwood Montessori School	School
Fauquier	Warrenton	Helena Carter Family Day Home	Day Care
Fauquier	Warrenton	Airlie Water Dam & Reservoir	Water Supply Facility
Fauquier	Warrenton	Warrenton Dam & Reservoir	Water Supply Facility
Madison	Madison	Madison County Sheriff's Office	Police Station
Madison	Madison	Madison Fire Company	Fire and Rescue
Madison	Madison	Madison Rescue Squad	Fire and Rescue
Madison	Madison	Madison Emergency Medical Services	Medical Services
Madison	Madison	School Bus Maintenance Shop	Mechanical Services
Madison	Madison	Rapidan Service Authority	Water Treatment Plant
Madison	Madison	School Board Offices	School Offices
Madison	Aroda	Cornerstone Christian School	School
Madison	Woodberry Forest	Woodberry Forest School	School
Madison	Aroda	Oak Grove Mennonite School	School
Madison	Madison	Madison County High	School

Madison	Madison	Madison Primary	School
Madison	Madison	Waverly Yowell Elementary	School
County	**Jurisdiction**	**Facility Name**	**Facility Type**
Madison	Madison	William H. Wetsel Middle	School
Madison	Madison	Criglersville Elementary	School
Madison	Madison	Early Learning Center	School
Madison	Madison	Skyline CAP	School
Madison	Town of Madison	First Friends Pre-school	School
Madison	Madison	Rainbow Preschool	Day Care
Madison	Pratts	Countryside Rest Home	Nursing Home
Madison	Novum	Meadowbrook Nursing Home at Novum	Nursing Home
Madison	Brightwood	Morgan’s Nursing Home	Nursing Home
Madison	Madison	Autumn Care of Madison	Nursing Home
Madison	Aroda	Mountain View Nursing Home	Nursing Home
Madison	Madison	Sevenoaks Pathwork Center	Nursing Home
Orange	Orange	Orange County Airport	Airport
Orange	Gordonsville	Gordonsville Municipal Airport	Airport
Orange	Orange	Orange County E-911 Center	Emergency Operations
Orange	Gordonsville	Gordonsville VFC	Fire Station
Orange	Orange	Orange VFC	Fire Station
Orange	Mine Run	Mine Run VFC	Fire Station
Orange	Barboursville	Barboursville Volunteer Fire	Fire Station
Orange	Rapidan	Rapidan Volunteer Fire Dept	Fire Station

Orange	Orange	Orange County Courthouse	Government Building
Orange	Orange	County Administrative Buildings	Government Building
County	**Jurisdiction**	**Facility Name**	**Facility Type**
Orange	Multiple Locations	County Parks & Recreation Facilities	Government Building
Orange	Multiple Locations	County Waste Facilities	Government Building
Orange	Gordonsville	Gordonsville Town Hall	Government Building
Orange	Orange	Central Virginia Regional Jail	Government Building
Orange	Orange	Orange Train Depot	Other
Orange	Orange	Town of Orange Water Treatment Plant	Water Treatment
Orange	Orange	Rapidan Service Authority Water Treatment Plant	Water Treatment
Orange	Orange	Rapidan Service Authority Wastewater Treatment Plant	Wastewater Treatment
Orange	Orange	Town of Orange Wastewater Treatment Plant	Wastewater Treatment
Orange	Multiple Locations	Power substations (REC, Dominion)	Utility
Orange	Orange	Shining Stars Childcare	Daycare
Orange	Orange	Dogwood Village	Nursing Home
Orange	Orange	Paul Stefan Foundation	Nursing Home
Orange	Rapidan	Holiday Home for Adults	Nursing Home
Orange	Gordonsville	Village at Gordon House	Assisted Living
Orange	Orange	AmeriHouse	Assisted Living
Orange	Orange	Belleview Senior Apartments	Assisted Living
Orange	Orange	Tiger Fuel	Fueling Station
Orange	Locust Grove	Lake-Woods Fire & Rescue	Fire & Rescue
Orange	Mine Run	Mine Run Volunteer Rescue	Rescue Squad

Orange	Barboursville	Barboursville Volunteer Rescue	Rescue Squad
Orange	Gordonsville	Gordonsville Volunteer Rescue	Rescue Squad
County	**Jurisdiction**	**Facility Name**	**Facility Type**
Orange	Orange	Orange County Rescue Squad	Rescue Squad
Orange	Orange	Orange County Sheriff's Office	Police Station
Orange	Orange	Orange Police	Police Station
Orange	Gordonsville	Gordonsville Police Dept	Police Station
Orange	Orange	Grymes Memorial School	School
Orange	Unionville	Faith Christian Academy	School
Orange	Unionville	Lightfoot Elementary	School
Orange	Orange	Orange County High	School
Orange	Orange	Orange Elementary	School
Orange	Orange	Prospect Heights Middle	School
Orange	Unionville	Unionville Elementary	School
Orange	Locust Grove	Locust Grove Elementary	School
Orange	Locust Grove	Locust Grove Middle School (old)	School
Orange	Gordonsville	Gordon-Barbour Elementary School	School
Orange	Locust Grove	Locust Grove Middle School (new)	School
Orange	Orange	Taylor Education Administration Complex	School
Orange	Orange	Town of Orange Public Works Facilities	Government Building
Orange	Orange	Town of Orange Administrative Building	Government Building
Orange	Orange	Standpipe & Concrete Reservoir	Water Supply Facility
Rappahannock	Washington	Sheriff's Office	Police Station

Rappahannock	Washington	Rappahannock County Courthouse	Government Building
Rappahannock	Washington	Rappahannock County Administrative Buildings	Government Building
County	**Jurisdiction**	**Facility Name**	**Facility Type**
Rappahannock	Washington	Co 1 Fire and Rescue	Fire Department
Rappahannock	Sperryville	Co 2 Fire and Rescue	Fire Department
Rappahannock	Amissville	Co 3 Fire and Rescue	Fire Department
Rappahannock	Flint Hill	Co 4 Fire and Rescue	Fire Department
Rappahannock	Castleton	Co 5 Fire and Rescue	Fire Department
Rappahannock	Sperryville	Co 7 Fire and Rescue	Fire Department
Rappahannock	Chester Gap	Co 9 Fire and Rescue	Fire Department
Rappahannock	Washington	Emergency Management Office	Emergency Management
Rappahannock	Sperryville	Hearthstone School	School
Rappahannock	Washington	Child Care and Learning Center	Day Care
Rappahannock	Washington	Rappahannock County Co-Op	Co-Op
Rappahannock	Sperryville	Belle Meade School	School
Rappahannock	Flint Hill	Wakefield Country Day School	School
Rappahannock	Washington	Rappahannock County High	School
Rappahannock	Washington	Rappahannock Elementary	School

Figure 6.2 Population Density

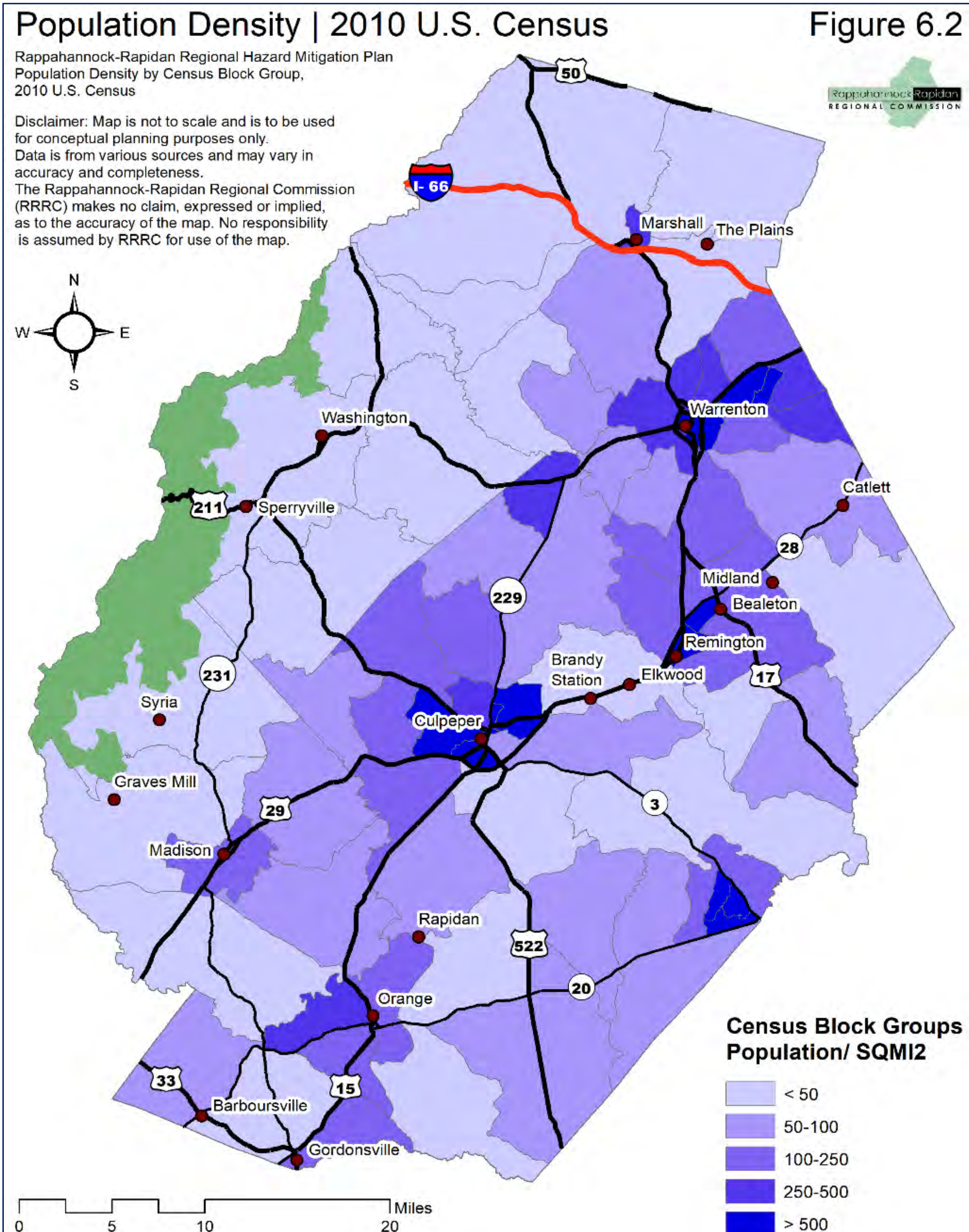


Figure 6.3 Residential Flood Exposure by Census Tract

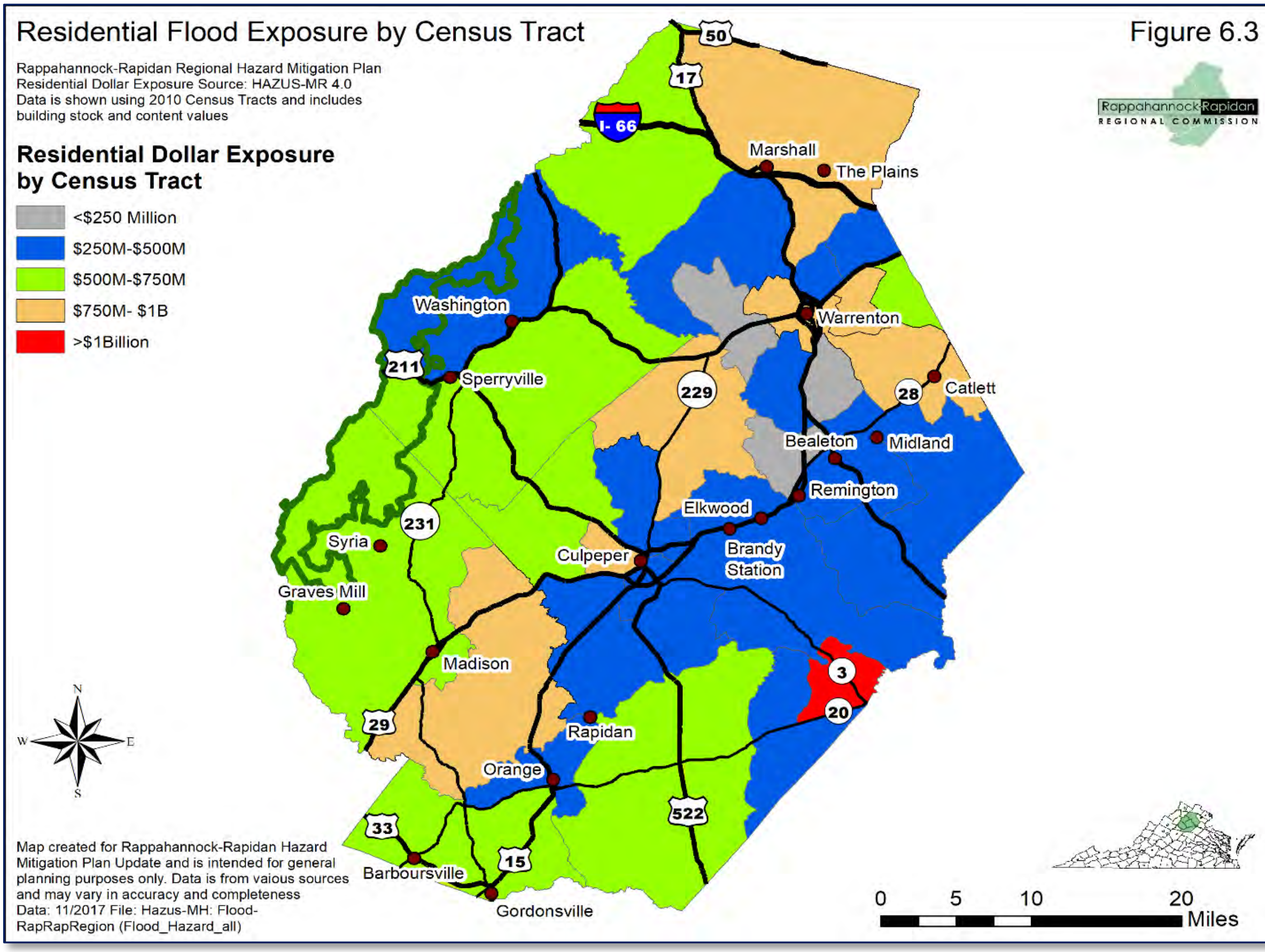


Figure 6.4 Commercial Flood Exposure

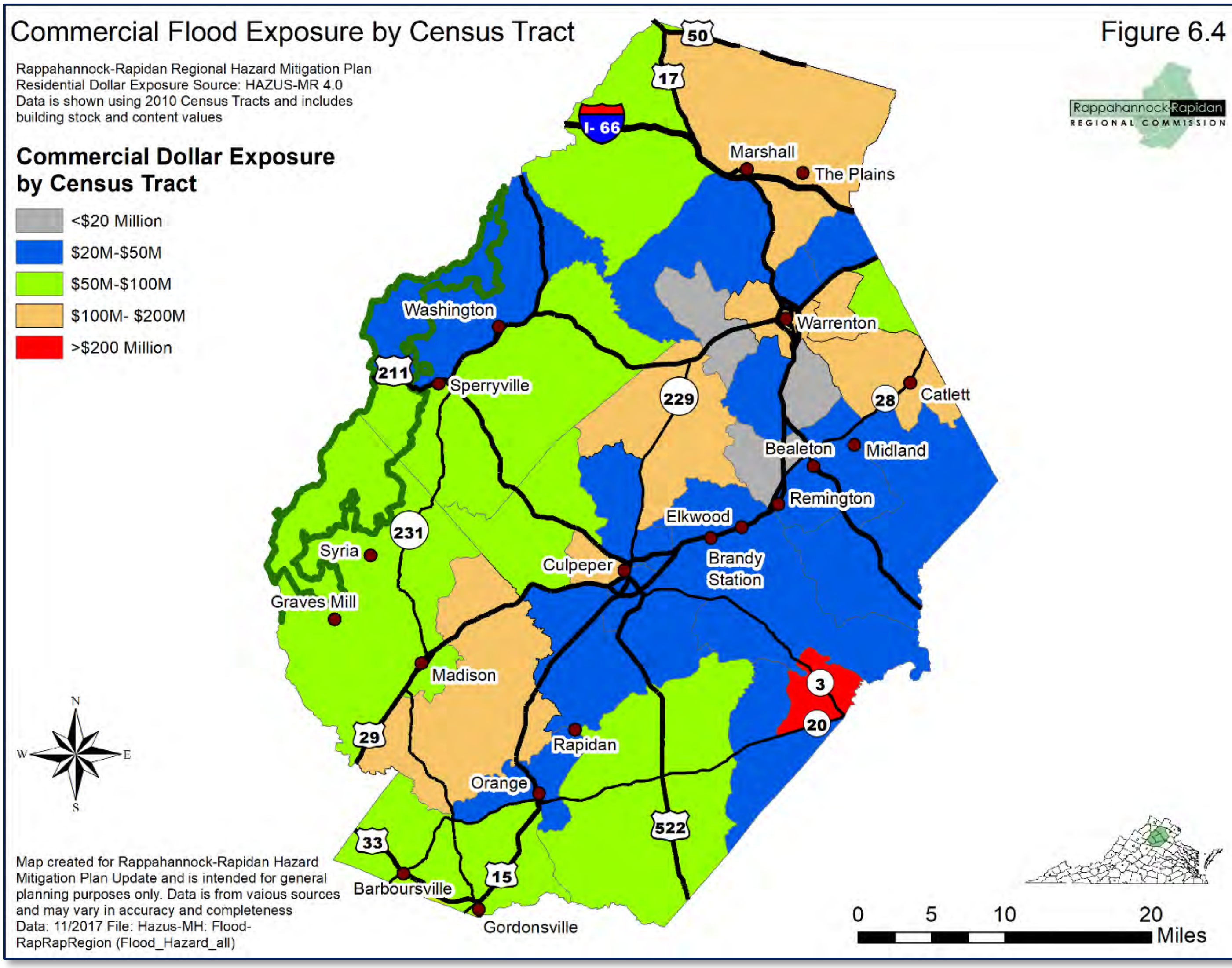


Figure 6.5 Industrial Flood Exposure by Census Tract

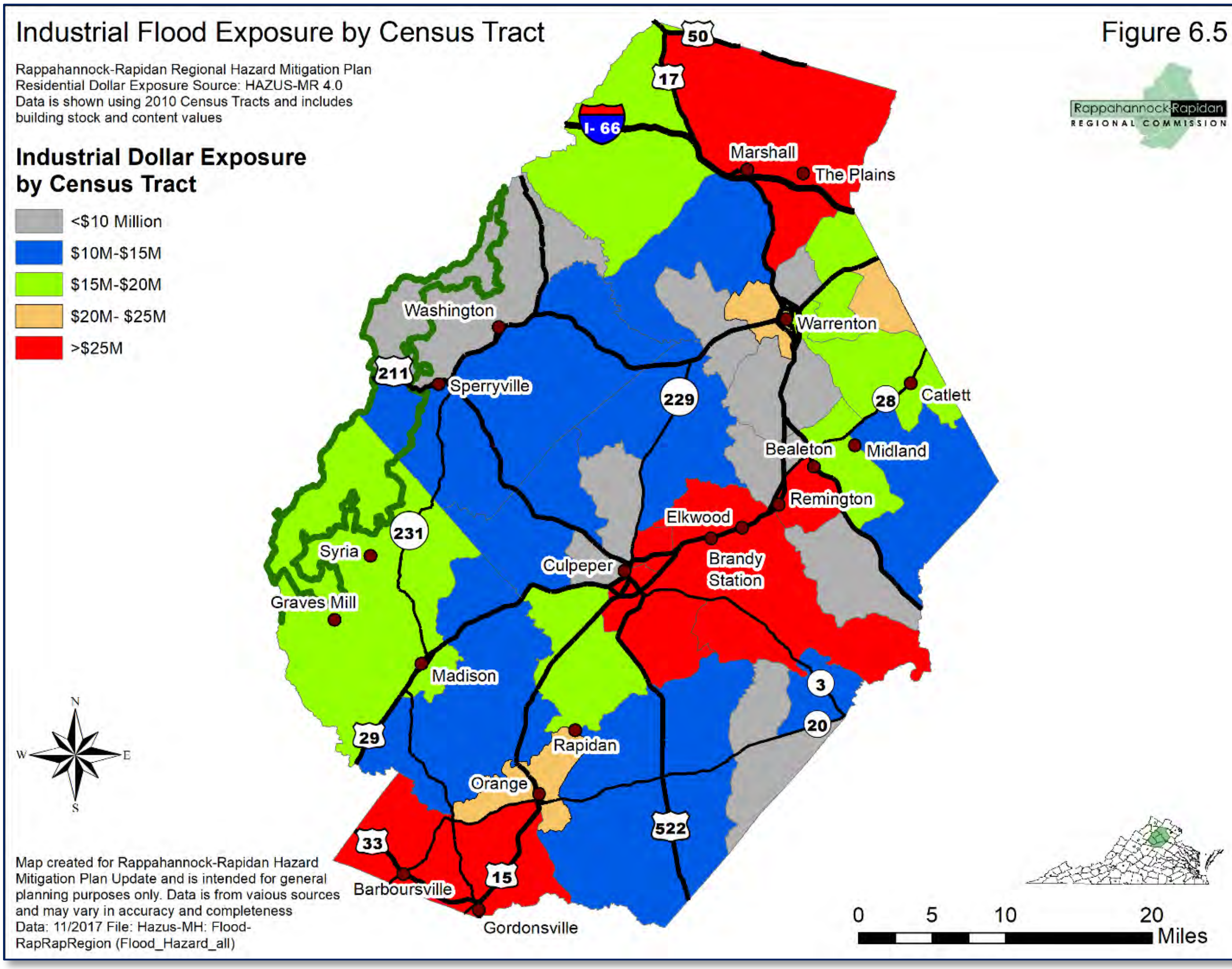


Figure 6.6 Critical Facilities

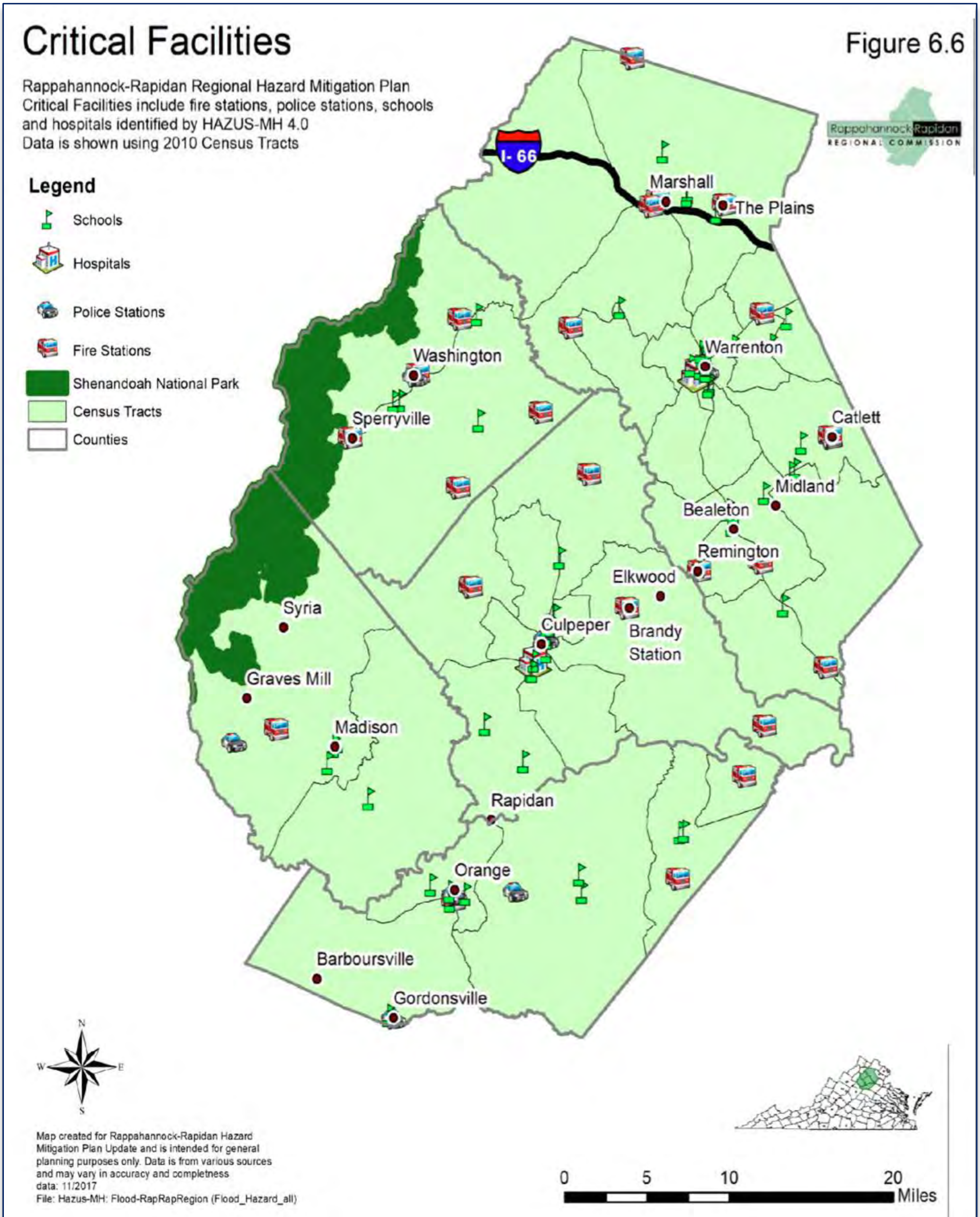
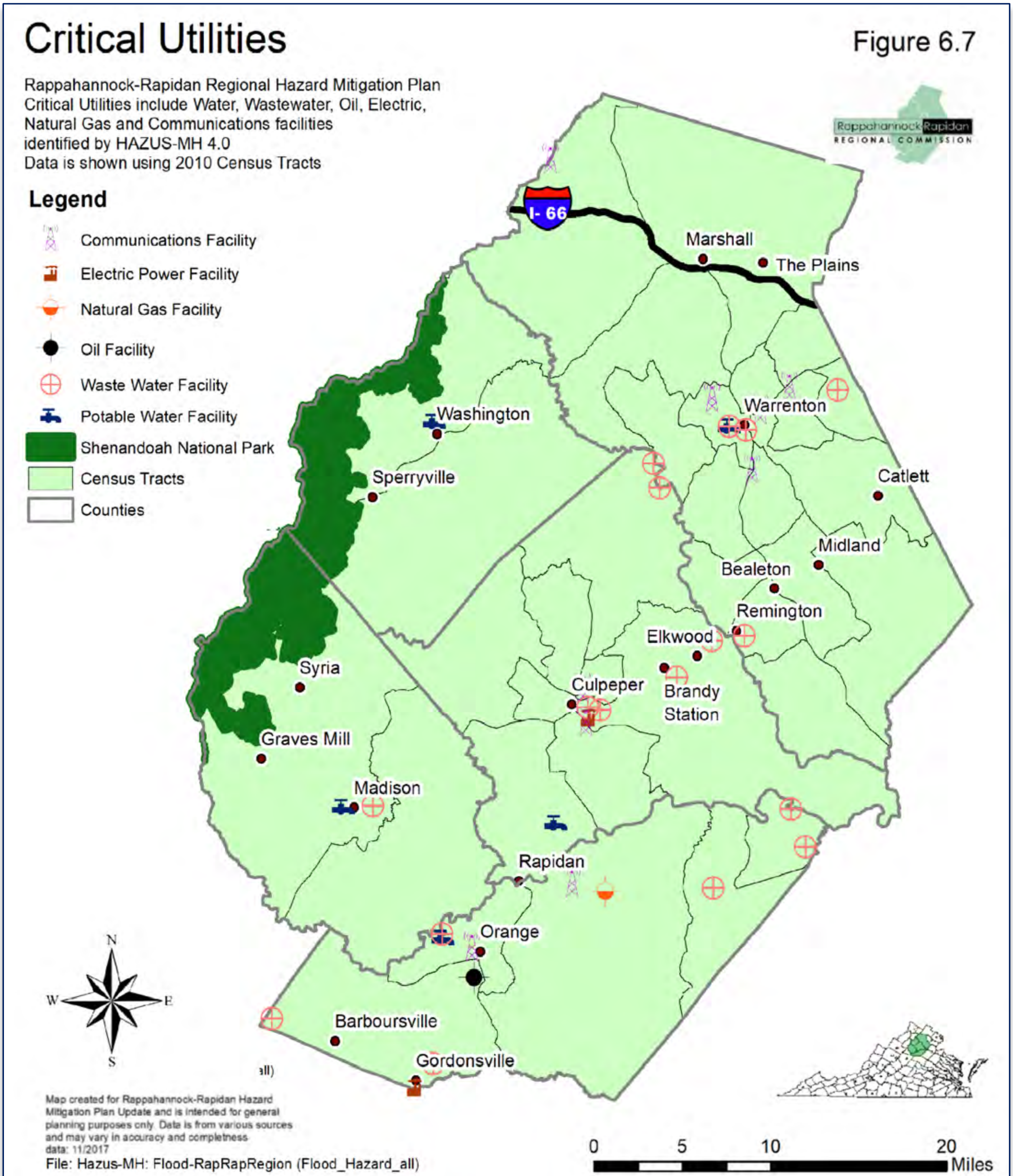


Figure 6.7 Critical Utilities



FLOOD

The vulnerability assessment for the flood hazard in the Rappahannock-Rapidan Region is based on two separate methodologies. The primary methodology utilized the Flood Modeling capabilities of HAZUS^{MH} MR4, using the default data provided with HAZUS^{MH} MR4. The basic analysis used the Flood Hazard Analysis process defined in chapter 3 of the HAZUS^{MH} MR4 User Manual – *Running HAZUS Flood with Default Data.*

Table 6.3 HAZUS Flood Hazard Analysis Process

Riverine Hazard	Coastal Hazard
USER DATA	
Define Terrain (Input DEM)	Define Terrain (Input DEM)
Import FIT Projects, User-Defined Depth Grids, HEC-RAS .FLT Grids	Import FIT Projects, User-Defined Depth Grids
Develop Stream Network	No Equivalent
CREATE NEW SCENARIO	
Select Reaches, FIT Projects, User-Defined Depth Grids, HEC-RAS Grids	Select Shorelines, FIT Projects, User-Defined Depth Grids
Hydrology	No Equivalent
No Equivalent	Characterize Shoreline
Delineate Floodplain (Hyrdraulics Analysis) for suite, single return period, specific discharge, annualized return periods	Delineate Floodplain (Frontal dune erosion, WHAFIS, wave runup, zone determination) for suite, single return period, annualized return periods
DEVELOP FLOODPLAIN DEPTH GRID (COMPLETED BASE HAZARD ANALYSIS)	
Optional Hazard Analysis Perform What If – Levee Assessment Perform What If – Flow Regulation Perform What If – Velocity Grid	Optional Hazard Analysis Perform What If – Long-Term Erosion Perform What If – Shore Protection

For the Rappahannock-Rapidan region, the analysis consisted of a Riverine Hazard assessment only. The HAZUS^{MH} MR4 hydraulics analysis was run for return periods of 10, 50, 100, 200 and 500 years in order to develop an annualized loss estimate for the entire region. The HAZUS^{MH} MR4 hydraulics analysis was run on 11/14/2017.

The HAZUS Flood Model analysis returned 131 reaches in the Rappahannock-Rapidan region, which were in turn divided into five scenarios in order to minimize processing time for the hydraulics analysis. The HAZUS analysis returned an annualized loss estimate of $17,515,000 for the Rappahannock-Rapidan study region. The HAZUS analysis did not return any essential facilities such as fire stations, hospitals, police stations and schools as resulting in a loss of use under a 500-year flood event scenario.

The secondary methodology utilized for the flood hazard vulnerability assessment was a spatial analysis of the structures and floodplains in the Rappahannock-Rapidan region. Using the maps developed in the *Hazard Analysis,* a table was created to capture the number and value of at-risk structures (Table 6.4) based on their intersection with known flood hazard boundaries

At-Risk Structures

A total of 9,224 parcels, which is about 9.6% of all parcels within the region, have been identified through GIS analysis as intersecting with the 100-year floodplain. Of these parcels, 5,987 were identified as having improvements on the property. The total improvements on these parcels intersecting the 100-year floodplain amounted to an assessed value of $1,009,438,202. The total value including land and improvements for all parcels intersecting the 100-year floodplain amount to $2,893,026,044.

Where data was available, these parcels were further analyzed to determine if the structures on those parcels were located in the 100-year floodplain. This analysis generated a total of 1,750 structures that are located in the floodplain. These "floodplain structures" amount to an assessed value of $313,032,900.

Table 6.4 Overview of Flood Vulnerability in the Rappahannock-Rapidan Region

Jurisdiction	NFIP Entry Date	Effective FIRM	Parcels Intersecting Floodplain	100-Year Floodplain (Zones AE and A)			
				Parcels with Structures Intersecting Floodplain	Structures Intersectin g Floodplain	Assessed Value	Annualized Losses
Culpeper County	7/1/1987	6/18/2007	1,422	84	277	$56,278,200	$562,782
Culpeper	3/2/1989	6/18/2007	501	178*	165	$62,392,300	$623,923
Fauquier County	11/1/1979	2/6/2008	4,422	475	762	$143,520,200	$1,435,202
Remington	3/18/1980	2/6/2008	267	129*	100	$13,909,900	$139,099
The Plains	NP		11	0	0	$0	$0
Warrenton	8/1/1979	2/6/2008	128	23	26	$29,235,100**	$292,351
Madison County	4/3/1989	1/5/2007	800	115	257	$24,823,000	$248,230
Madison	NP	None	0	0	0	$0	$0
Orange County	9/10/1984	1/2/2008	916	33	50	$6,379,300	$63,793
Town of Orange	1/2/2008	NSFHA	0	0	0	0	0
Gordonsville	NP		29	4	5	$587,100	$5,871
Rappahannock County	8/24/1984	1/5/2007	715	71	108	$5,142,900	$51,429
Washington	1/5/2007	1/5/2007	13	0	0	$0	$0
REGIONWIDE TOTALS			**9,224**	**934**	**1,750**	**$313,032,900**	**$3,130,329**

1. County data shown above does not include towns
2. Some structures cross multiple parcels likely muiti-family housing such as townhouses*
3. Of total almost $20,000,000 from small portion of Wastewater Plant and Golds Gym in the flood zone**

Annualized Losses for Flood

The HAZUS[MH] MR4 Flood Hazard Riverine Analysis generated an annualized loss estimate of $17,515,000 for the region. **Table 6.5** shows the annualized loss estimates by county, inclusive of capital stock losses (building damage cost, contents damage cost and inventory loss) and income losses (relocation loss, capital related loss, wages losses and rental income loss).

Table 6.5 HAZUS MR4 Flood Hazard Annualized Losses, by County In Thousands of Dollars

	Capital Stock Losses			Income Losses				
County	Building Damage	Contents Damage	Inventory Loss	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total
Culpeper	4,079	3,586	72	1	2	11	0	7,751
Fauquier	3,257	2,019	12	0	0	2	0	5,276
Madison	835	463	1	0	0	0	0	1,299
Orange	1,342	849	10	1	0	0	0	2,202
Rappahannock	686	462	3	0	0	0	0	1,151
R-R Region	10,199	7,379	98	2	2	13	0	17,693

From the non-HAZUS GIS analysis, two annualized loss figures were calculated. The first figure was generated by assuming 100 percent loss to all improvements on parcels intersecting the floodplain during a 100-year flood event. This annualized loss estimate was $10,094,382.

The second annualized estimate was generated by assuming 100 percent loss to all improvements on parcels with structures intersecting the floodplain during a 100-year flood event. This annualized loss estimate was $3,130,329.

National Flood Insurance Program Data

As of September 30, 2017, there were 407 properties enrolled in the National Flood Insurance Program in the Rappahannock-Rapidan Region. These policies amounted to $327,652.00 in total premiums and $109,882,700.00 in total insurance coverage (Table 6.6). Included in the appendix of this plan are *What-If Scenarios* for each jurisdiction related to the reduction in NFIP costs based on Community Rating System participation.

Table 6.6 National Flood Insurance Policy Information for the Rappahannock Rapidan Region

Community Name	Policies in force	Insurance in force	Premiums in force
Culpeper County	41	$10,423,200.00	$20,043.00
Culpeper	42	$10,881,600.00	$41,015.00
Fauquier County	144	$37,884,500.00	$104,127.00
Remington	37	$8,594,400.00	$49,815.00
Warrenton	20	$7,330,500.00	$29,084.00
Madison County	36	$10,000,100.00	$23,510.00
Madison	0		
Orange County	47	$13,845,800.00	$22,380.00
Gordonsville	0		
Orange	3	$588,000.00	$923.00
Rappahannock County	37	$10,274,600.00	$36,755.00
Washington	0		
REGION TOTALS:	**407**	**$109,882,700.00**	**$327,652.00**

Data as of 09/30/2017

Repetitive Loss Properties

The identification of repetitive loss properties is an important element to conducting a local flood risk assessment, as the inherent characteristics of properties with multiple flood losses strongly suggest that they will be threatened by continual losses. Repetitive loss properties are also important to the National Flood Insurance Program, since structures that flood frequently put a strain on the National Flood Insurance Fund. A strong goal of FEMA is to reduce the numbers of structures that meet these criteria, whether through elevation, acquisition, relocation or a flood control project that lessens the potential for continual losses. The NFIP defines repetitive loss as two or more claims of at least $1,000 over a 10-year period. This is the data that appears in this plan. The Hazard Mitigation Assistance (HMA) program defines repetitive loss as having incurred flood-related damage on two occasions, in which the cost of repair, on average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and, at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

According to FEMA, there are currently 6 repetitive loss properties within the jurisdictions of the Rappahannock Rapidan Region (Table 6.7). However, because of the relatively low amount of claims paid for these properties, none of these properties are on FEMA's national "Target 10,000" list of the most concerning repetitive loss properties in the Nation. Specific addresses of the properties shown in here are deliberately not included in this Plan as required by law.

Table 6.7 NFIP Repetitive Loss Properties in the Rappahannock Rapidan Region

Jurisdiction	Flood Zone	Number of Insured Losses	Mitigated	Structure Type
Madison	AE	2	No	Other, Commercial
Culpeper	A	2	No	Commercial, Commercial
Orange	A	1	No	Residential
Warrenton	A	1	No	Commercial
TOTAL		**6**		

Source: Virginia Department of Emergency Management

HURRICANES AND TROPICAL STORMS

Historical evidence shows that the Rappahannock-Rapidan Region is vulnerable to damaging hurricane and tropical storm-force winds. While the Rappahannock-Rapidan region has historically seen several hurricanes pass through the region, the tropical storms generally weaken as they move over land and do not possess the same power as they do when they make landfall in more coastal areas of Virginia and the East Coast of the United States. Loss estimates for wind were developed based on probabilistic scenarios using HAZUS^{MH} (Level 1 analysis). Table 6.8 shows number of structures damaged and estimated losses for 50, 100 and 500-year return periods. In order to provide a summary of potential wind-related losses, an annualized loss estimate of $491,000 was derived from the HAZUS^{MH} assessment.

Table 6.8 HAZUS Estimates of Potential Losses for Hurricane-Force Winds

Level of Event	Approximate Number of Structures Damaged	Estimated Losses
50-year Storm	17	$433,000
100-year Storm	37	$6,688,000
500-year Storm	805	$54,432,000

SEVERE THUNDERSTORMS AND TORNADOES

Historical evidence shows that most of the state is vulnerable to thunderstorm and tornado activity. These particular hazards are often associated with one another, as tornadoes often result from severe thunderstorm activity. Tornadoes may also occur during a tropical storm or hurricane. However, because it cannot be predicted where thunderstorm and tornado damage may occur, the total dollar exposure figure of $22,426,422,000 for buildings and facilities within the region is considered to be exposed and could potentially be affected.

For the severe thunderstorm and tornado hazards, best available data on historical hazard occurrences (limited to NOAA National Climatic Data Center records) was used to produce an annualized loss estimate of potential damages for each county. Using this data, annualized loss estimates were generated by totaling the amount of property damage for each county over the period of time for which records were available and calculating the average annual loss. In instances where multiple counties are affected and the value for property damage reflects the total for the affected area, the average property damage for each county was calculated to produce an annualized loss estimate of potential damages for each county. Damages associated with lightning and hail activity were included in the severe thunderstorm calculations. Based on historic property damages, a regional annualized loss estimate of $259,231 was generated for severe thunderstorms. A regional annualized loss of $262,527 was generated for tornadoes.

WILDFIRE

Based on information obtained from the Virginia Department of Forestry for events reported from 2005-2010 included in the *Hazard Analysis* section of this plan, the annualized loss for the region is $42,523. Fires that occurred on federal lands are not included in this assessment. This will lower the actual expected annualized loss for certain counties, especially those with portions of their county located in Shenandoah National Park. Current or more historic data on losses caused by wildfire incidents are not available, and may present an opportunity for future data collection and analysis outside of the five-year plan update process.

DROUGHT & EXTREME HEAT

The entire Rappahannock-Rapidan Region is vulnerable to drought. Since 1995, the counties in the Rappahannock-Rapidan region have been affected by drought on several occasions, most notably in 1999 and 2002. The National Climatic Data Center attributes nearly $31 million in crop loss to these events. It is assumed that all buildings and facilities are exposed to drought but would experience negligible damage in the occurrence of a drought event, but crop damages would naturally suffer the greatest amount of damage. This is of particular importance to officials in this region, as farming is a major industry in the region. Additionally, before this period, very little historical data exists on past drought events. Therefore, it is very difficult to determine an annualized loss that can be expected for the region due to drought. Based upon the events discussed in the *Hazard Analysis* section, the regional annualized loss estimate for the Rappahannock-Rapidan Region is $1,535,000. The majority of that value is for losses to crops and farmlands caused by drought events from 1995 to 2015.

The annualized loss estimate for drought may be somewhat inflated because of the unusually high periods of drought that have occurred recently and the lack of historical drought data before 1995 to counterbalance the recent events. However, the likelihood of future impacts from both extreme heat and drought is high given past prolonged events and risks can be assumed to affect all parts of the region.

WINTER STORMS

For the winter storm hazard, best available data on historical hazard occurrences (limited to NOAA National Climatic Data Center records) was used to produce an annualized loss estimate of potential damages for each county. Using this data, annualized loss estimates were generated by totaling the amount of property damage for each county over the period of time for which records were available, and calculating the average annual loss. In instances where multiple counties are affected and the value for property damage reflects the total for the affected area, the average property damage for each county was calculated to produce an annualized loss estimate of potential damages for each county.

Unlike hazards such as tornadoes that typically impact a specific location, winter storms most often affect large geographic areas and often impact multiple counties. Based on estimated historical property damages for the Rappahannock-Rapidan Region due to winter storms, an annualized loss estimate of $135,425 for this hazard was calculated. Potential losses may be further inflated by additional factors not represented in this estimate, such as costs associated with the removal of snow from roadways, debris clean-up, some indirect losses from power outages, etc.

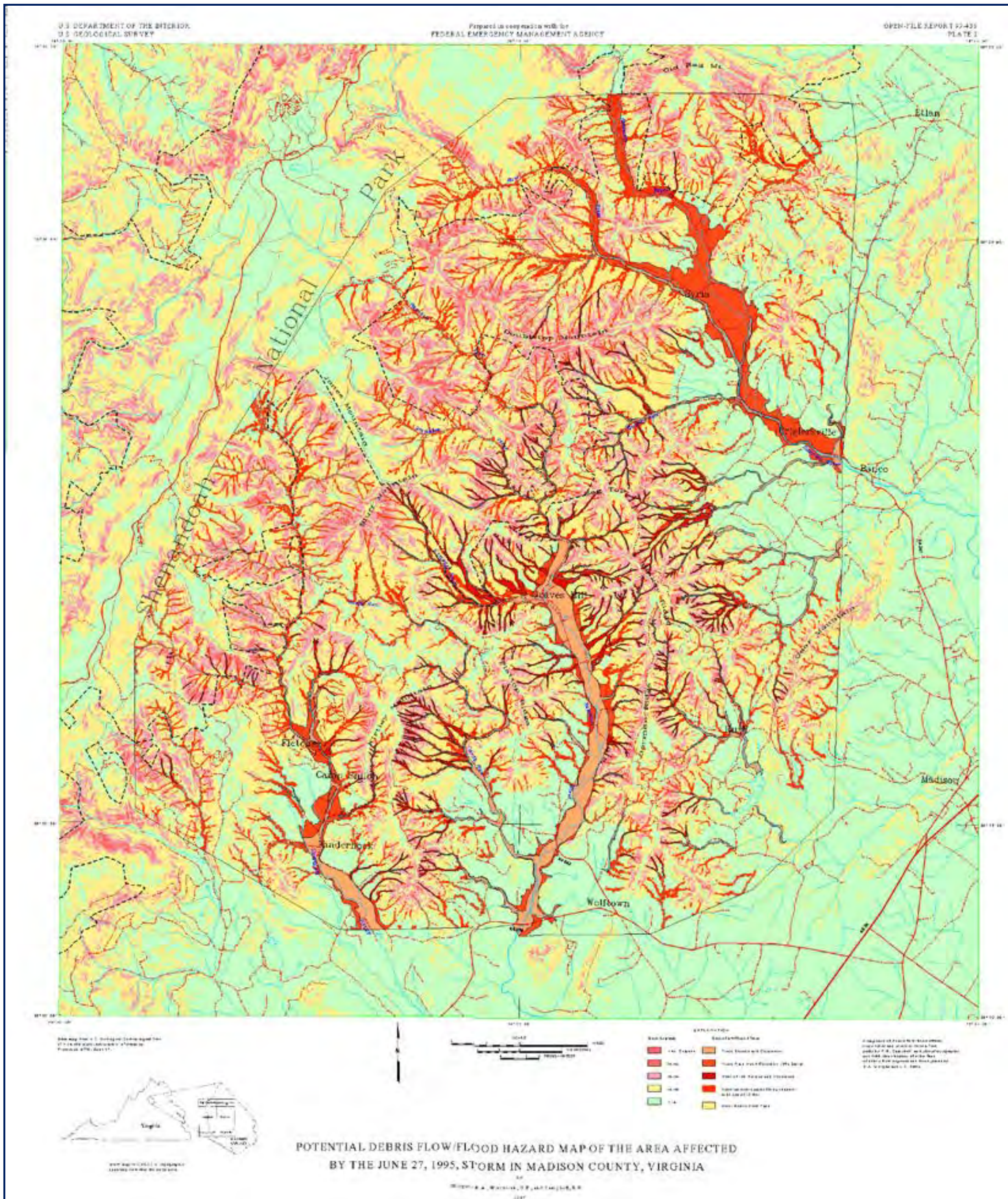
A qualitative factor in terms of vulnerability to winter storms in the Rappahannock-Rapidan Region is the fact that severe winter storms occur more frequently than in other parts of the state and therefore there is, not surprisingly, a high level of awareness on the part of residents in the region in preparing for and responding to winter storm conditions in a manner that will minimize the danger to themselves and others. This heightened awareness is especially important to cutting down on the number of traffic accidents caused by negligent drivers.

EARTHQUAKES

According to the maps in the *Hazard Analysis* section, the region's risk to earthquakes can be considered limited; however, the risk of potential losses should a significant earthquake event occur—for example an earthquake registering 8.5 on the Richter Scale—is considered to be moderate. Still, USGS Earthquake Search reports just five measurable earthquakes in the region since 1974, all with magnitude less than 3.2 on the Richter Scale. Using HAZUS's probabilistic earthquake modeling program, an annualized loss estimate of $360,000 was derived for the Rappahannock-Rapidan region.

The August 23, 2011 earthquake had an epicenter in Mineral, Louisa County, located south of the Rappahannock-Rapidan region. Damages were most severe in Louisa County, but there were significant damages in Culpeper and Orange counties, resulting in FEMA identifying those counties as eligible for Individual Assistance on December 29, 2011.

Figure 6.8 USGS Landslide Study for Madison County



LAND SUBSIDENCE (KARST AND/OR SINKHOLES)

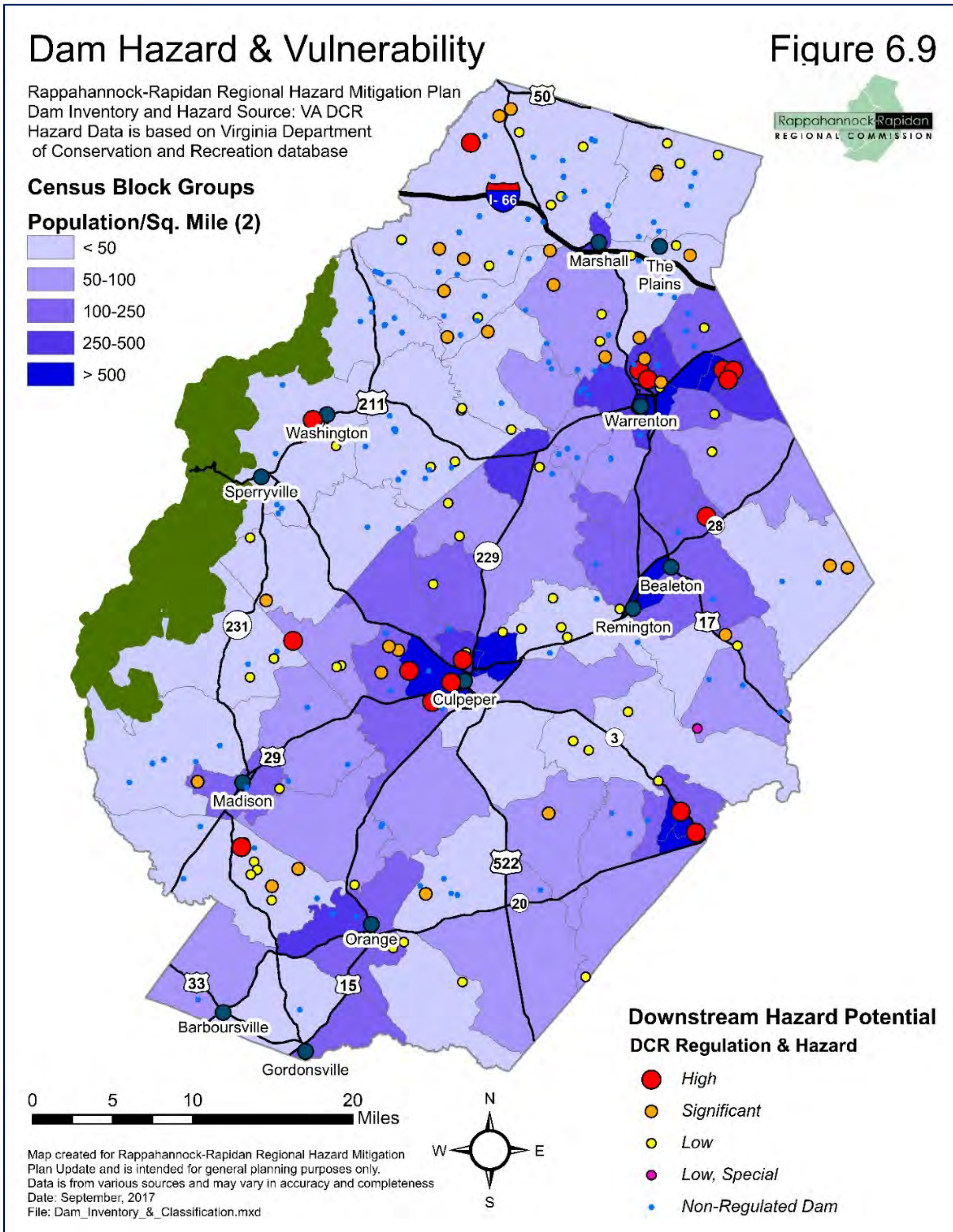
Any damage resulting from a sinkhole or landslide would be localized and, due to the uniform nature of risk to these hazards on a countywide scale, it is not possible to generate maps or tables showing potential loss estimates or particularly at-risk structures or properties. Due to sinkholes occurring in the region in the past, it can be expected that they will occur again in the future, however, vulnerability is considered to be negligible because these events are very random and do not effect a large area

LANDSLIDES & EROSION

There is no simple methodology in place for determining the region's vulnerability to landslides. The maps in Section 5 provide a general indication of the areas that could expect to experience a landslide, however, it is extremely difficult to determine the number of buildings and people at risk. Future updates of this Plan may explore this landslide vulnerability is greater detail.

However, as a result of the June 27, 1995 storm that wreaked havoc in Madison County, the United States Geological Survey (USGS) conducted a survey that analyzed the damage caused by that storm and did a limited amount of project areas of potential future damages (See Figure 6.9). This report can be obtained from the USGS or online at http://geohazards.cr.usgs.gov/pubs/ofr/97-438/97-438.html.
Erosion vulnerability for the region is difficult to determine because there are no historical records for previous occurrences of erosion events. Vulnerability is limited to areas along rivers, creeks and streams to areas of steep slopes. Future updates to this Plan may attempt to address erosion vulnerability in greater detail.

Figure 6.9 Dam Hazard & Vulnerability



DAM FAILURE

Figure 6.9 shows the location of dams in the Rappahannock-Rapidan Region in relation to population density. Whereas this may not support any conclusive correlation between dam breaches or failures and affected populations, it does aid the planning process by visually placing all known state-regulated dams in direct relationship to population distribution.

Also included in the appendix of this plan are dam break inundation zone maps for several of the larger dams in the region, including Lake Pelham and Mountain Run Lake in Culpeper, Warrenton Lake in Fauquier County, Lake of the Woods and Lake Orange in Orange County.

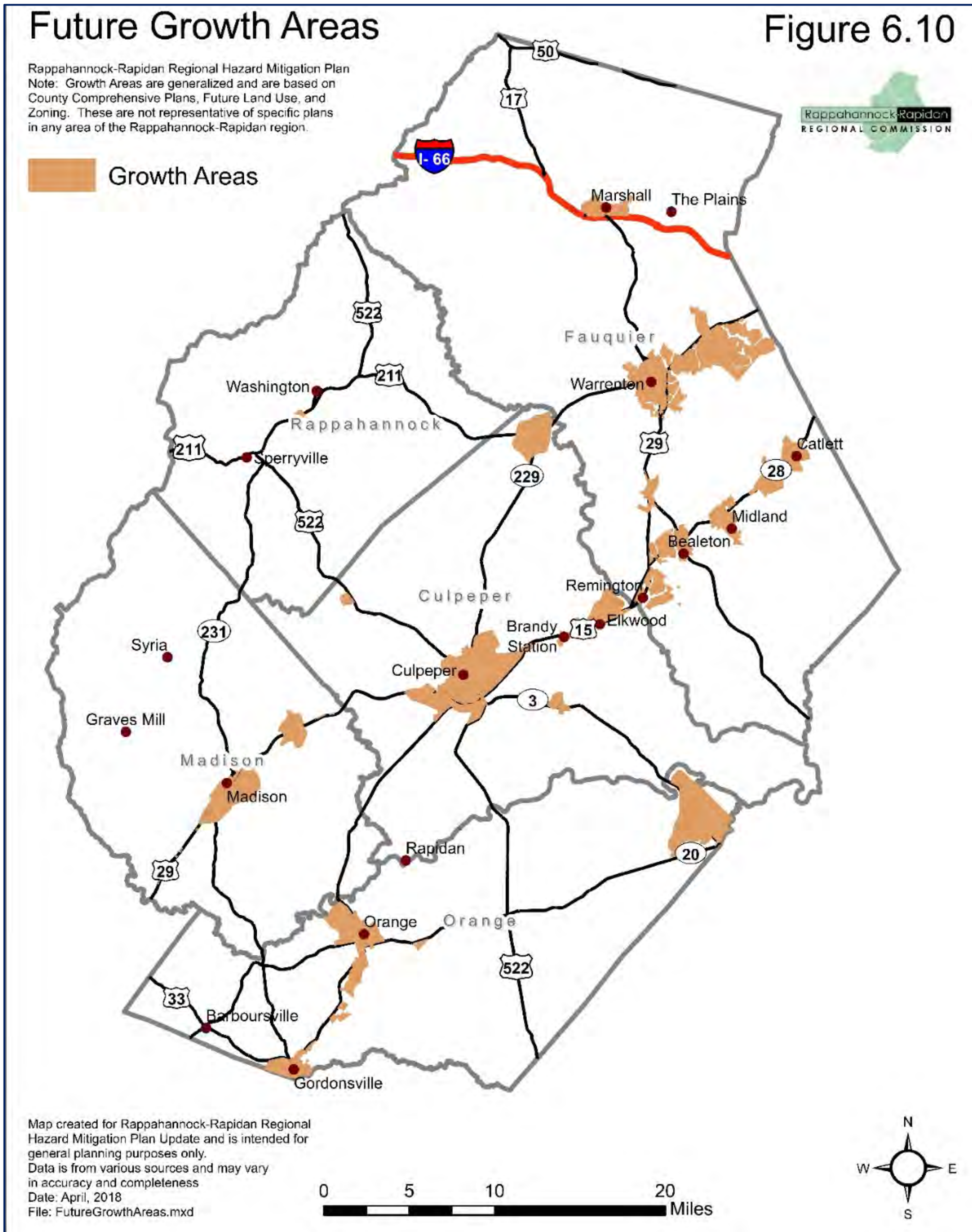
Future updates of the Plan may include a detailed analysis of the property directly downstream of the high hazard dams in order to better determine the amount of property vulnerable to a dam breach.

Portions of the Rappahannock-Rapidan Region are experiencing rapid development as the Washington, DC metropolitan area continues to move westward. The vulnerability of future buildings, infrastructure and critical facilities is a great concern to community leaders across the region. As discussed in the *Capability Assessment* section of this Plan, many of the day-to-day activities in local governments in the region are designed to deal with these challenges.

Land uses and development trends in the region are briefly discussed in this section and in the *Community Profile*. The map to the right (Figure 6.10) shows future growth areas in the region as identified through adopted future land use plans and/or zoning that may indicate likely growth areas.

Future plan updates will continue to address development trends and future vulnerability (to include the number and types of future buildings, infrastructure, and critical facilities located in the identified hazard areas) in more detail, in particular for hazards with a spatially defined hazard boundary, such as flood. Such analysis should include overlay mapping of growth areas with identified hazard boundaries.

Figure 6.10 Dam Hazard & Vulnerability



UNIQUE RISKS FOR LOCAL JURISDICTIONS

Participating jurisdictions in a multi-jurisdictional Hazard Mitigation plan have the option of identifying unique risks to their locality. These risks may be identified as having a higher impact on the locality when compared to the overall regional risk assessment or may be particular risk factors that are important to note as part of the overall Hazard Mitigation planning process. In the Rappahannock-Rapidan region, the Counties of Culpeper, Fauquier, and Rappahannock, and the Towns of Culpeper, Orange, Remington, and Warrenton have identified unique risks as part of the Hazard Mitigation planning process. These risks are summarized below:

Jurisdiction: Town of Orange

Unique Hazards:

- Railroad goes right through the middle of East Main Street. Various chemicals and hazardous materials are transported by train frequently.
- Natural Gas Plant in Unionville (piped throughout county)
- Proximity to North Anna Nuclear Power Plant
- Interstate corridor (Interstates 64 and 95) increases truck traffic

Populations at Risk: The entire population – dependent on type of chemical or event and wind direction.
Special Populations at Risk: Nursing residents, senior citizens, mental health assisted facility
Property at Risk: There are approximately thirty businesses in downtown that are vulnerable to the railroad. For all the other hazards, the entire county and all the property within the county are at risk to the listed unique hazards.

Jurisdiction: Rappahannock County, Madison County

Unique Hazard:

- The presence of Shenandoah National Park means that wildfire is both a heightened risk as well as an unmanageable one. The risk for Rappahannock and Madison counties is classified as high.

Populations at Risk: The entire population (approximately 300-500 people) along the Western border of the County. 1/5 of the County is in the park.
Special Populations at Risk: None
Property at Risk: 125 houses, valued at approximately $16 million, 50 commercial structures valued at approximately $12 million

Jurisdiction: Culpeper County

Unique Hazard:

- Earthquake

Populations at Risk: The entire population
Special Populations at Risk: All populations are at risk.
Property at Risk: In response to the August 23, 2011 earthquake and associated damage, Culpeper County officials identified the earthquake hazard as a high-risk hazard in the county.

Jurisdiction: Town of Culpeper

Unique Hazards:

- Dams at Lake Pelham and Mountain Run Lake

Populations at Risk: Town of Culpeper, portions of Culpeper County
Special Populations at Risk: Aging population, Assisted Living facilities
Property at Risk: Town estimates commercial and residential structures at risk to be 1,048. Cost would require additional study.
Key Facilities/Infrastructure at Risk: Town of Culpeper Water Treatment and Wastewater Treatment facilities and electric utilities

Jurisdiction: Fauquier County
Unique Hazards: • Railroad Infrastructure. Approximately 58 miles of single-track railroad runs through the County transporting various hazardous materials.
Populations at Risk: All populations depending on where accident on the rail occurs and the type of material being transported **Special Populations at Risk:** Elderly, Residents Near Railroad Track, Public Schools/Child Care Centers **Property at Risk:** Public Schools (5 Elementary, 2 Middle, 2 High), 2 Child Care Centers, 13 Tier II Facilities

Jurisdiction: Town of Remington
Unique Hazards: • Transportation Infrastructure (Railroad)
Populations at Risk: All populations are potentially at risk, depending on event **Special Populations at Risk:** Elderly, Remington Group Home **Property at Risk:** All buildings potentially at risk

Jurisdiction: Town of Madison
Unique Hazards: • Wildfire (Forested Areas Surrounding Town structures) • Hazardous Materials (Route 29 Haz Mat route)
Populations at Risk: All populations are potentially at risk, depending on event **Special Populations at Risk:** Elderly, Autumn Care facility **Property at Risk:** All buildings potentially at risk

Table 6.9 Summary of Potential Annualized Losses (From Quantitative Assessment)

Hazard	Estimated Annualized Losses
Flood	$3,130,329*
Drought	$1,535,000
Hurricanes	$491,000
Earthquakes	$360,000
Tornadoes	$262,527
Severe Thunderstorms (includes Lightning & Hail)	$259,231
Winter Storms	$135,425
Wildfire	$42,522**
Sinkholes	Unknown
Landslides	Unknown
Erosion	Unknown
Dam/Levee Failure	Unknown

Table includes flood hazard estimate generated by non-HAZUS GIS analysis
****Virginia DOF estimates indicate that over $11,000,000 in property is saved annually as a result of DOF fire response in the Rappahannock-Rapidan region***

Based upon the qualitative approach defined in detail under Methodologies Used, the risk from natural hazards in the Rappahannock-Rapidan Region was weighed by the Mitigation Advisory Committee and criteria was used to assign values to the likelihood of occurrence, spatial extent affected, and potential impact of each hazard. These values combined to form a total rating for each hazard (Table 6.9). The top three hazards identified through this process are flood, hurricanes and tropical storms and winter storms.

Table 6.10 Hazard Risk Ratings (From Qualitative Assessment)

Hazard	Likelihood	Spatial Extent	Potential Impact	HAZARD RATING
Flood	Highly Likely (3)	Moderate (2)	Critical (3)	**8**
Severe Thunderstorms and Tornadoes	Highly Likely (3)	Small (1)	Critical (3)	**7**
Winter Storms	Likely (2)	Large (3)	Limited (2)	**7**
Hurricanes and Tropical Storms	Possible (1)	Large (3)	Limited (2)	**6**
Drought	Possible (1)	Large (3)	Limited (2)	**6**
Wildfire	Highly Likely (3)	Moderate (2)	Minor (1)	**6**
Earthquakes	Possible (1)	Large (3)	Minor (1)	**5**
Dam Failure	Possible (1)	Moderate (2)	Limited (2)	**5**
Landslides /Erosion	Possible (1)	Small (1)	Limited (2)	**4**
Sinkholes and/or Karst	Possible (1)	Small (1)	Minor (1)	**3**

The conclusions drawn from the qualitative and quantitative assessments, combined with final determinations from the Mitigation Advisory Committee, were fitted into three categories for a final summary of hazard risk based on High, Moderate or Low designations (Table 6.11). The three high-risk hazards identified through this process are the flood, the severe thunderstorm/tornado, and the winter storm hazards. The three moderate-risk hazards identified are the drought, hurricanes/tropical storms, and wildfire hazards. All other hazards are classified as low risk.

Table 6.11 Estimated Risk Levels for the Rappahannock-Rapidan Region (Combination of Qualitative and Quantitative Assessments

HIGH RISK HAZARDS	Flood	Severe Thunderstorms & Tornadoes		Winter Storms
MODERATE RISK HAZARDS	Drought	Hurricanes & Tropical Storms		Wildfire
LOW RISK HAZARDS	Earthquake	Sinkholes and/or Karst	Landslides and/or Erosion	Dam Failure

The prioritization in the 2018 revision to the Rappahannock-Rapidan Regional Hazard Mitigation Plan reflects one modification from the 2012 version. The Severe Thunderstorm & Tornado hazard was elevated from moderate to high-risk based on recent event history and greater likelihood and impact to the region. The Hurricane & Tropical Storm hazard was moved from high-risk in 2012 to moderate risk in 2018. The main impact of that hazard results from flooding due to periods of sustained rainfall, along with high winds. However, the number of hurricanes and tropical storms impacting the region is not as high as other hazards listed as high-risk.

It should be noted that although some hazards may show Moderate or Low risk, hazard occurrence is still possible. Also, any hazard occurrence could potentially cause a sizable impact and losses could be extremely high (i.e., an F5 tornado or a destructive earthquake).

PURPOSE

The Rappahannock-Rapidan region's capability assessment is used to determine the ability of participating localities to develop and implement mitigation strategies and to identify opportunities, or needs, to establish or enhance specific policies, programs or projects. The assessment was used to determine the feasibility of achieving proposed goals and objectives based on an understanding of the organizational capacity of those agencies or departments tasked with their implementation.

By inventorying each jurisdiction's relevant ordinances, programs and policies it was possible to determine local capabilities and identify gaps, shortfalls and weaknesses that might compromise effective hazard mitigation. In addition, proven programs of verifiable benefit were identified and targeted for continued support and possible enhancement. The assessment helped determine the practicality of specific mitigation actions and the likelihood of their implementation in consideration of a local government's planning and regulatory framework, level of administrative and technical support, amount of fiscal resources and current political climate.

Coupled with the Risk Assessment, the Capability Assessment helped identify and refine appropriate mitigation actions for incorporation into the Mitigation Strategy section of the Hazard Mitigation Plan and ensured that specific goals and objectives are realistically achievable.

PROCEDURE

For the 2018 plan update, RRRC staff worked with local jurisdictions points of contact to complete two tasks related to the capability assessment.

1) A review of Table 7.1 from the 2012 Hazard Mitigation Plan was completed by each locality to document any changes to the local plans currently in place. Table 7.1 documents several common planning documents, ordinances, codes, and policies in place and documents whether each participating locality utilizes each. This table was first developed in 2005 and is described below:

In order to facilitate the inventory and analysis of local government capabilities throughout the Rappahannock-Rapidan Region, a detailed Capability Assessment Survey was distributed to the participating Rappahannock-Rapidan Region local municipal jurisdictions, including five counties and six towns. The survey questionnaire, which was completed by applicable local government officials, requested information on a variety of “capability indicators” such as existing local plans, policies, programs or ordinances that contribute to and/or hinder the community’s ability to implement hazard mitigation actions. Other indicators included information related to each jurisdiction’s fiscal, administrative and technical capabilities such as access to local budgetary and personnel resources for mitigation purposes.

2) Participating jurisdictions were also asked to provide additional information for the capability assessment through a set of worksheets developed by FEMA to document and assess local capabilities. These worksheets requested information on each locality’s planning and regulatory capabilities, administrative and technical resources, financial tools and resources, and education and outreach capacity. Copies of the completed worksheets can be found in the Appendix of the 2018 plan.

FINDINGS

Findings are summarized as follows based on the set of worksheets completed by each jurisdiction. Information is presented based on five categories capability identified below:

- Planning and Regulatory Capability
- Administrative/Technical Capability
- Fiscal Capability
- Education & Outreach
- Emergency Management

Planning and Regulatory Capability

Planning and regulatory capability is demonstrated by the formulation and implementation of plans, ordinances, programs and policies by a jurisdiction that reflects commitment to responsible growth and land management with a clear focus on community safety and welfare. Along with effective land use and transportation planning, capability is expressed by the presence and enforcement of comprehensive zoning and subdivision ordinances and building codes, as well as effective emergency response and mitigation planning. Attention to, and protection of, environmental, historical and cultural resources are additional elements of demonstrated capability.

This assessment provides an overview of the key planning and regulatory tools and programs in place, or under development, in the Rappahannock-Rapidan region. Along with identifying potential effects on loss reduction, this information helps determine opportunities to address existing gaps, weaknesses or conflicts among existing strategies and will facilitate integrating this plan with other existing and future planning mechanisms.

Administrative and Technical Capability

The ability of a locality to develop and implement mitigation projects, policies and programs is related directly to its capacity to dedicate staff time and resources to those purposes. Administrative capability is demonstrated by the identification of sufficient, qualified personnel, effective and efficient assignment of tasks, and comprehensive program oversight. Effective Inter-departmental and intergovernmental communication and cooperation also reflects administrative capability. Technical capacity and capability is determined by evaluating specific knowledge and skills, as well as the assessment of appropriate certifications and licensing requirements.

In general, the counties in the region have a high level of administrative and technical capability, through administrative, emergency management, building, and planning/zoning staff. The larger towns (Culpeper, Warrenton, Orange, Gordonsville) are also able to provide administrative and technical oversight via their own staff, but the smaller towns (Madison, Remington) employ limited staff and rely heavily on their respective county staffs and/or private firms for technical assistance.

Grant writing and administration is a key component towards implementation of local and regional mitigation strategies. In general, jurisdictions in the Rappahannock-Rapidan region rely on staff to identify, develop and administer grants for identified projects in their localities. Most of these staff members also have other primary job functions, in addition to their grant responsibilities. The Rappahannock-Rapidan Regional Commission has provided grant-writing and administrative assistance to its member jurisdictions and also facilitates inter-jurisdictional grant efforts, as possible.

Fiscal Capability

The level of funding available determines a locality's ability to develop and implement policies and projects in all areas of interest and responsibility. Costs associated with hazard mitigation planning and program development vary widely from funds needed to meet staffing requirements to those for the acquisition of costly equipment and, sometimes, flood-prone homes. Often, substantial commitments are needed from local, state and federal sources.

While most of the counties and larger towns in the Rappahannock-Rapidan region have the technical expertise to carry out large scale grant-funded projects, local matching funds can be difficult to secure. The smaller towns in the region have limited budgets and limited staff and would be unlikely to meet mitigation grant matching requirements.

Education and Outreach

Education and outreach activities are used to inform residents, businesses, government agencies, visitors, and property owners about hazards, potential impacts from hazards, pending events, and opportunities for mitigation of the impacts from hazards. Public awareness of natural hazards is an important component of mitigation planning and in achieving the dual goals of reducing loss of life and economic impacts of natural hazards. Education and outreach can take on many forms, including public speaking, informational materials such as brochures or posters, mapping of hazard information, targeted education series to specific segments of the population, and joint outreach efforts with public, non-profit, and private partner organizations.

Emergency Management

Hazard mitigation is recognized as one of the four primary aspects of emergency management. Others are preparedness, response and recovery, and the four aspects are interconnected and interdependent. Planning for each aspect is critical to the development of a comprehensive emergency management program and key to the successful implementation of hazard mitigation actions.
Counties and Towns in the Rappahannock-Rapidan region have made concerted efforts to incorporate mitigation into their Emergency Management and Emergency Services programs in order to enhance local and regional preparedness, response, and recovery. Such efforts are often interconnected with education and outreach, administrative, technical, and fiscal capacity of each jurisdiction.

Table 7-1 provides a summary of the relevant tools already adopted or being developed by the Rappahannock-Rapidan region's participating local governments based on information from previous versions of the Rappahannock-Rapidan Hazard Mitigation plan and input from the jurisdictions during the 2018 update. A summary discussion of the plans, ordinances, and programs can be found below the table.

Relevant Plan Information

Hazard Mitigation Plan – A community's blueprint for reducing the impact of natural and human-caused hazards on people and the built environment. The essential elements of a hazard mitigation plan include a risk assessment, capability assessment and mitigation strategy. The Rappahannock-Rapidan region's first All Hazard Mitigation Plan was adopted in 2005 with subsequent reviews and revisions completed in 2012 and 2018. The hazard mitigation plan has been maintained and implemented by the Rappahannock-Rapidan Regional Commission and each of the participating localities.

Disaster Recovery Plan - Guides the physical, social, environmental and economic recovery and reconstruction process following a disaster. Often, hazard mitigation principles and practices are incorporated into local disaster recovery plans to capitalize on opportunities to break the cycle of repetitive disaster losses.

- Survey results indicate that only three of the jurisdictions have their own disaster recovery plan, three reference the state plan, and the remaining jurisdictions do not have a disaster recovery plan. All localities may consider whether to develop their own disaster recovery plan that would incorporate mitigation opportunities into the disaster recovery process.

Emergency Operations Plan – Includes detailed responsibilities and procedures to be followed to deploy resources in response to an emergency or disaster. Periodic review and update of emergency operations plans assures improved readiness. Focusing on preparedness and response, rather than hazard mitigation, emergency operations planning has been determined to have a moderate effect on loss reduction.

- Each of the five counties in the Rappahannock-Rapidan Region Emergency Management maintains its own emergency operations plan that also covers their respective towns.

Table 7.1 Capability Assessment Summary Matrix

Jurisdiction	National Flood Insurance Program	NFIP Community Rating System	Comprehensive Land Use Plan	Hazard Mitigation Plan	Disaster Recovery Plan	Floodplain Management Plan	Stormwater Management Plan	Emergency Operations Plan	Continuity of Operations Plan	Radiological Emergency Plan	SARA Title III Plan	Evacuation Plan	Transportation Plan	Capital Improvements Plan	Historic Preservation Plan	Zoning Ordinance	Subdivision Ordinance	Flood Damage Prevention Ordinance	Building Code	Fire Code	Riparian Buffer/ Wetland Preservation	Non-Governmental Organization	Open Space Preservation	Public/Private Partnerships
Culpeper County	x		x	x	Δ		Δ	x	x	x	x	x	x	x	x	x	x	x	Δ	Δ		X		
Town of Culpeper	x		x	x	Δ	x	Δ	•	•	•		•	x	x	x	x	x	x	Δ	Δ	x	X		
Fauquier County	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Δ	Δ	x	X	x	x
Town of Warrenton	x		x	x		x	x	•	•		x		x	x	x	x	x		Δ	Δ	x	X		
Town of Remington	x		x	x	x	x	Δ	•	•	•	•	•	•			X	X	X	Δ	Δ		X		x
Madison County	x		x	x		x	Δ	x			x	x	x	x	x	x	x		Δ	Δ		X		
Town of Madison			x	x		•	Δ	•			•	•			x	x	x		Δ	Δ		X		
Orange County	x		x	x	Δ	x	Δ	x	x	x	x	x	x	x	x	x	x	x	Δ	Δ		X		
Town of Gordonsville	x		x	x			Δ	•	•	•	•	•							Δ	Δ		X		
Town of Orange	x		x	x			Δ	•	•	•	•	x	x	x		x	x		Δ	Δ		X		
Rappahannock County	x		x	x	x	x	Δ	x		x	x	x			x	x	x	x	Δ	Δ	x	X		x

X – Local Plan Adopted or in Development • Uses County Plan Δ - Uses State Plan

Continuity of Operation Plan: Establishes a chain of command, line of succession, and plans for backup or alternate emergency response resources in case of an extreme emergency. Developing a continuity of operation plan is an example of hazard mitigation.

- With the development of a continuity of operations plan by Culpeper County since the original plan was written, the region now has three jurisdictions with such a plan in place. Each of the other jurisdictions is encouraged to consider preparing their own continuity of operations plans as a possible mitigation action for inclusion this Plan.

Radiological Emergency Plan: Delineates roles and responsibilities for assigned personnel and the means to deploy resources in the event of a radiological accident.

- Four of the five counties in the Rappahannock-Rapidan Region have a radiological emergency plan. Three towns rely on their respective county plans. One county and two towns do not have a plan.

SARA Title III Emergency Response Plan: Outlines the procedures to be followed in the event of a chemical emergency such as the accidental release of toxic substances. These plans are required by federal law under

Title III of the Superfund Amendments and Re-authorization Act (SARA), also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

- Culpeper County is now included in the number of jurisdictions within the region that have a SARA Title III Emergency Response Plan, bringing the total to all five. One town has its own plan, one relies on the county and three do not have a plan.

Comprehensive Land Use Plan: Establishes the overall vision for a community and serves as a guide for future decision making. Typically, a comprehensive plan includes a summary of current and expected demographic conditions, land use patterns, transportation networks and facilities and community resources. The integration of hazard mitigation measures into the comprehensive plan can greatly enhance the likelihood of achieving risk reduction goals, objectives and actions.

- As required by the Commonwealth, all jurisdictions within the region have a comprehensive land use plan.

Capital Improvements Plan: Guides the scheduling of spending for public improvement projects. A capital improvements plan can serve as an important mechanism to guide future development away from identified hazard areas. Limiting public spending in hazardous areas is one of the most effective long-term mitigation actions available to local governments.

- Four of the five counties, with the exception of Rappahannock County, in the Rappahannock-Rapidan region maintain Capital Improvement Plans. Of the participating towns, the towns of Culpeper, Orange, and Warrenton also have adopted Capital Improvements Plans.

Historic Preservation Plan: Guides the impact of community decisions on historic structures or districts within a community. An often overlooked aspect of the historic preservation plan is the assessment of buildings and sites located in areas subject to natural hazards to identify the most effective way to reduce future damage. Effective strategies may involve relocation or retrofits to protect buildings that do not meet current standards buildings and/or are within a historic district and cannot be moved.

- All five counties in the Rappahannock-Rapidan region reference preservation in local ordinances and Fauquier County has a Preservation Planner on staff in its Department of Community Development. Three of the five participating towns also have similar ordinances in place.

Zoning Ordinance: Protects public health, safety and welfare by regulating the location, type and density of development occurring within a jurisdiction. A powerful planning tool, a zoning ordinance can effectively eliminate development in identified hazard areas.

- All participating jurisdictions have a zoning ordinance.

Subdivision Ordinance: Regulates residential, commercial and industrial development along with associated infrastructure. Subdivision design that accounts for natural hazards can dramatically reduce impacts to development.

- All participating jurisdictions have a subdivision ordinance.

Building Codes, Permitting and Inspections: The Commonwealth of Virginia adopted the 2012 Virginia Uniform Statewide Building Code (USBC), which went into effect on July 14, 2014. The USBC references and amends the 2012 International Code Counsel (ICC) family of codes to include the International Building Code, International Rehabilitation Code and the International Residential Code.

The purpose of USBC is to protect the health, safety and welfare of the residents of the Commonwealth of Virginia, provided that buildings and structures should be permitted to be constructed at the least possible cost consistent with recognized standards of health, safety, energy conservation and water conservation, including provisions necessary to prevent overcrowding, rodent or insect infestation, and garbage accumulation; and barrier-free provisions for the physically handicapped and aged.

- All jurisdictions adhere to the Commonwealth of Virginia 2012 Uniform Statewide Building Code that went into effect on July 14, 2014.

The adoption and enforcement of building codes by local jurisdictions are routinely assessed through the Building Code Effectiveness Grading Schedule (BCEGS) program developed by the Insurance Services Office, Inc. (ISO). Assessment results are provided to ISO's member private insurance companies, which in turn, may offer ratings credits for new buildings constructed in communities with strong BCEGS classifications. Communities with well-enforced, up-to-date codes typically have fewer losses, reflected in lower insurance rates. Personnel qualifications, continuing education opportunities and number of inspections conducted daily are included in the assessment which determines a jurisdiction's grade. Grades range from 1 to 10, with the lower grade preferred. A BCEGS grade of 1 represents exemplary commitment to building code enforcement, and a grade of 10 indicates less than minimum recognized protection. Table 7.2 lists the BCEGS ratings for the jurisdictions in the region.

Table 7.2 BCEGS Ratings in the Region

Jurisdiction	BCEGS Residential Rating	BCEGS Commercial Rating	Year of Evaluation
Culpeper County	4	4	2006
Culpeper	Covered by Culpeper County		
Fauquier County	3	3	2000
Remington	Covered by Fauquier County		
Warrenton	4.4	4.4	2006
Orange County	4	4	1998
Gordonsville	Covered by Orange County		
Orange	Covered by Orange County		
Madison County	4	4	2008
Madison	Covered by Madison County		
Rappahannock County	4	4	1998

Floodplain Management

Flooding is the most significant of all natural hazards facing the nation. Tools available to reduce associated impacts are among the most developed and comprehensive when compared with other hazard-specific mitigation techniques. In addition to education, outreach, and specific training strategies, the National Flood Insurance Program (NFIP) enables local governments to determine where and how development occurs relative to identified flood hazards. Although voluntary, participation in the program is strongly encouraged by FEMA. The NFIP maps flood hazard areas and develops Flood Insurance Rate Maps (FIRMs) which are used to assess flood hazard risk, regulate construction practices and set flood insurance rates. Recognized as a key element in the development, implementation and sustainability of an effective hazard mitigation program, affiliation with the NFIP is a measure of local capability.

Participation in the NFIP requires the adoption of a local ordinance establishing minimum standards to prevent impacts to structures from the 100 year flood. Requirements for improvements to existing buildings, special standards for new construction and assurance that new development will not exacerbate existing flood potential must be included.

An additional indicator of floodplain management capability is active participation in the Community Rating System (CRS). The CRS is an incentive-based program that encourages counties and municipalities to undertake defined flood mitigation activities that exceed the minimum requirements of the NFIP. Each of eighteen specific CRS mitigation activities are assigned a range of point values. As points are accumulated and identified thresholds reached, communities may apply for an improved CRS class the designation of which will result in flood insurance premium reductions as shown in Table 7.3.

CRS Class	Premium Reduction
1	45%
2	40%
3	35%
4	30%
5	25%
6	20%
7	15%
8	10%
9	5%
10	0

Table 7.3 CRS Premium Discounts, by class

Participation in the CRS is voluntary. Any community that is in full compliance with the rules and regulations of the NFIP may apply to FEMA for a CRS classification better than class 10. As part of the 2018 update to the Rappahannock-Rapidan Regional Hazard Mitigation plan, CRS What-If Scenarios were produced for each jurisdiction in the region to estimate the potential savings and number of policies that would be positively impacted by participation in the Community Rating System at the various classes shown above. The results of these scenarios are provided in the appendix of this plan.

- There are currently no CRS communities in the Rappahannock-Rapidan Region.

Floodplain Management Plan: Provides a framework for the development and implementation of corrective and preventative measures to reduce flood-related impacts.

- Several of the participating jurisdictions have Floodplain Management Plans in place, while others have specific references to floodplains within their respective local ordinances.

Stormwater Management Plan: Addresses flooding associated with stormwater runoff and is focused on the design and implementation of construction practices to reduce the impact of urban flooding.

- Changes to the Virginia Stormwater Management Program in 2014 resulted in portions of Fauquier County and the Town of Warrenton being designated as local authorities with MS-4 permits. The other four counties, and their respective towns, are classified as “opt-out” localities with VSMP permitting overseen by the Virginia Department of Environmental Quality.

INTRODUCTION

A mitigation strategy provides participating localities, as well as the region as a whole, with the basis of actions for reducing the impacts of identified hazards. Based on the findings of the *Risk Assessment* and the *Capability Assessment*, the mission statement, goals and actions that follow are intended to guide both the day-to-day operations and the long-term approach taken by counties and towns to reduce the impacts of hazards. Components of the Mitigation Strategy include:

- Mitigation Goals;
- Identification and Analysis of Mitigation Measures; and
- Mitigation Action Plan

The RRRC Hazard Mitigation Plan, as revised, continues to be both comprehensive and strategic. The plan includes a thorough review of identified hazards and targets policies and projects that will reduce future impacts and assist the region, and its localities, in achieving compatible economic, environmental and social goals. In addition, the plan links policies and project to agencies, departments or individuals responsible for their implementation. When possible, funding sources to be used in project implementation are identified.

The Mitigation Action Plan (MAP) lists specific tactics, including descriptions, those responsible for implementation, potential funding sources, and estimated completion dates. This format provides a comprehensive checklist that can be used as a monitoring tool and ready reference of proposed policies and projects.

PLANNING APPROACH

The Plan follows a traditional planning approach, beginning with a mission statement that provides the overall guiding principle, goals designed to meet the intent of the mission statement, and mitigation actions which include policies or projects designed to reduce the impacts of future hazard events. Each step provides a clearly defined set of policies and projects based on a rational framework for action. The components of the planning framework are as follows:

Mission Statement:	Provides the guiding principle of the Hazard Mitigation Plan.
Goals:	Provide the framework for achieving the intent of the mission statement.
Hazard Mitigation Policies:	Proposed actions agreed to by members of the Planning Team.
Hazard Mitigation Projects:	Specific actions to address defined vulnerabilities to existing buildings or systems; potential funding sources are included.
Mitigation Action Plan:	Prioritized listing of policies and projects, including mitigation techniques, hazards addressed, individual or organization responsible for implementation, estimated completion date, and potential funding source(s).

MISSION STATEMENT

Reduce the physical and economic impacts of natural hazards on the jurisdictions within the Rappahannock-Rapidan Region through effective hazard mitigation techniques.

MITIGATION GOALS

The goals listed below are the result of an inclusive planning process described in Section 2. The goals were created as part of a brainstorming session, where county and municipal representatives agreed upon broad mitigation categories that provided the basis for the formulation of regional mitigation goals. Mitigation categories and goal statements are listed below:

MITIGATION CATEGORIES

The categories developed at the regional Mitigation Strategy Workshop were evaluated, commonalities were identified across counties, and goal statements were developed that encompass the Rappahannock-Rapidan Region. These goal statements are:

MITIGATION GOALS

- Goal #1: Improve and update data needed for hazard mitigation purposes within the Rappahannock-Rapidan Regional Commission and local jurisdiction offices.
- Goal #2: Implement policies that incorporate mitigation planning into the framework of local government in the Rappahannock-Rapidan region.
- Goal #3: Implement sound planning techniques throughout the region that compliment the benefits of hazard mitigation.
- Goal #4: Implement cost effective structural projects throughout the region to reduce the impact of future disaster events.
- Goal #5: Conduct training throughout the region for employees to improve response capabilities of local emergency management officials and to educate local officials of benefits of hazard mitigation techniques.
- Goal #6: Implement meaningful education and outreach projects throughout the region to educate the public about the dangers of natural hazards and how they can protect their families and their property.
- Goal #7: Improve regional evacuation and sheltering capabilities for response to all identified hazards, including the potential impacts of an evacuation of the Washington D.C. area.

IDENTIFICATION AND ANALYSIS OF MITIGATION MEASURES

In formulating this Mitigation Strategy, a wide range of activities were considered in order to help achieve the goals of participating jurisdictions. All actions chosen by county and town government officials fell into one of the broad categories of mitigation techniques listed below.

MITIGATION TECHNIQUES

1. Prevention

Preventative activities 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
- Hazard Mapping
- Open Space Preservation
- Floodplain Regulations
- Stormwater Management
- Drainage System Maintenance
- Capital Improvements Programming
- Shoreline Management

2. Property Protection

Property protection measures may include improved structural stability, removal of structures from hazard-prone locations, or insurance subscription to cover potential loss. Examples include:

- Acquisition
- Relocation
- Building Elevation
- Critical Facilities Protection
- Retrofitting (i.e., wind proofing, flood proofing, etc.)
- Insurance
- Safe Room Construction

3. Natural Resource Protection

Natural resource protection not only reduces hazard impacts but preserves and/or restores the function of natural systems. Thus, lives and property are protected, and environmental goals, including improved water quality and protection of wildlife habitat, are enhanced. Examples include:

- Floodplain Protection
- Riparian Buffers
- Fire Resistant Landscaping
- Erosion and Sediment Control
- Wetland Restoration
- Habitat Preservation
- Slope Stabilization

4. Structural Projects

Structural mitigation projects reduce hazard impacts by modifying the environment or hardening structures. Examples include:

- Reservoirs/Dam Stabilization
- Detention and Retention Basins
- Channel Modification/Stabilization
- Storm Sewer Construction/Maintenance

5. Emergency Services

Although not typically considered a mitigation technique, emergency services minimize the impact of a hazard on people and property. Actions taken immediately prior to, during, or in response to a hazard event include:

- Warning Systems
- Search and Rescue
- Evacuation Planning and Management
- Flood Mitigation Techniques

6. Public Information and Awareness

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

- Outreach and Education
- Training
- Speaker Series, Demonstration Events
- Property Disclosure
- Hazard Expositions

MITIGATION ACTION PLAN

The mitigation actions developed and adopted by participating jurisdictions are listed in the Appendix of this plan. Figure 8.1 represents the general information collected for the specific mitigation actions. Each action was designed to achieve the goals identified in the RRRC Mitigation Strategy. Each jurisdiction's mitigation actions form the basis of their Mitigation Action Plan. By identifying specific projects and policies, the Mitigation Action Plans provide the framework for participating localities to engage in distinct actions that will reduce the impacts of future hazard events and disasters.

Figure 8.1 Mitigation Action Worksheet

Mitigation Action	
a. Community Name:	
b. Action Item (Describe):	
c. Hazard(s):	
d. Lead Agency/ Department Responsible:	
e. Estimated Cost:	
f. Funding Method: (General Revenue, Contingency/ Bonds, External Sources, etc.)	
g. Implementation Schedule:	
h. Priority:	

a) Community Name

b) **Action Item**: Identify and describe specific actions that, if accomplished, will reduce vulnerability and risk in the impact area. Actions should match mitigation goals.

c) **Hazard(s)**: Describe/list hazard(s) the action attempts to mitigate.

d) **Lead Agency/ Department Responsible**: Identify the local agency, department or organization best suited to accomplish this action.

e) **Estimated Cost**: If applicable, estimate the cost to accomplish the mitigation action.

f) **Funding Method**: If applicable, indicate how the action will be funded; funds may be provided from existing operating budgets (General Revenue), a previously established contingency fund (Contingency/ Bonds), or a federal or state grant (External Sources).

g) **Implementation Schedule**: Indicate when the action will begin, and when it is expected to be completed.

h) **Priority**: Indicate whether the action is a 1) High priority – short-term immediate – reducing overall risk to life and property; 2) Moderate priority – an action that should be implemented in the near future due to political or community support or ease of implementation; 3) Low priority – an action that should be implemented over the long term that may depend on the availability of funds. Local representatives reviewed the priority levels and made changes based on local capacity and necessity of implementation.

Mitigation Techniques in the RRRC Planning Area

County and town officials reviewed the findings of the Capability Assessment and Risk Assessment in order to determine feasible and effective mitigation techniques. The Disaster Mitigation Act of 2000 specifies that state and local governments should prioritize actions based on the level of risk a hazard poses to the lives and property of a given jurisdiction. The Mitigation Matrix (Figure 8.2) served as a general guide; assisting local governments to make sure that they addressed, at a minimum, those hazards posing the greatest threat. Mitigation techniques, including prevention, property protection, natural resource protection, structural projects, emergency services, and public information and awareness were noted in the matrix if adopted by a participating jurisdiction. It is important to note that local and regional Mitigation Action Plans in the RRRC planning area included an array of actions, not just those addressing high and moderate risk hazards.

Figure 8.2 Mitigation Matrix

MITIGATION TECHNIQUES	Flood	Severe Thunderstorm & Tornadoes	Winter Storm	Drought	Earthquake	Hurricanes and Tropical Storms	Wildfire
Prevention	X	X	X	X	X	X	X
Property Protection	X						
Natural Resource Protection	X			X			X
Structural Projects	X	X	X	X	X	X	X
Emergency Services	X	X	X	X	X	X	X
Public Information and Awareness	X	X	X	X	X	X	X

The bulk of the mitigation actions identified by local governments address the flood hazard. This is primarily because of two reasons: 1) The flood hazard was identified through the Risk Assessment to be one of the high risk hazards that impact the region, and 2) The flood hazard is probably the easiest hazard to plan for and mitigate the impacts of.

There are also mitigation actions to address each of the other high and moderate risk hazards identified in the Risk Assessment, as well as other lower risk hazards. Each jurisdiction reviewed the existing strategies and added new strategies, as applicable. Strategies to ensure participation and compliance with the National Flood Insurance Program are included and there are additional strategies related to public education and outreach for FIRM updates that are presently underway in both the Potomac and Rappahannock River watersheds.

As part of the 2018 revision to the Rappahannock-Rapidan Regional Hazard Mitigation Plan, participating jurisdictions updated the progress on the proposed mitigation strategies from the previously approved versions of the plan (2005 and 2012). In general, most localities have made progress on their identified mitigation strategies, through enhanced public outreach activities, structural and safety improvements of critical infrastructure, ordinance reviews, floodplain reviews and management, and GIS implementation and development. Highlights of activities underway or completed between 2005 through the 2018 update include:

- The Town of Culpeper received funding assistance from USDA NRCS and the Department of Conservation and Recreation to complete dam rehabilitation projects at both the Mountain Run Lake Dam and Lake Pelham Dam. Construction is expected to be complete by December 2018, resulting in enhanced dam safety impacting residents and businesses in the Town of Culpeper and portions of Culpeper County.
- Orange County addressed several of its mitigation strategies, including a county-wide evacuation plan and the development of a terrorism response plan, as part of its ongoing Emergency Operations plan updates. Orange County also began planning for a consolidated public safety facility to enhance communication between emergency management, fire and emergency services, E-911, and GIS staff.

- Fauquier County addressed several of its mitigation strategies through updated ordinances, including retaining natural vegetative bed in stormwater channels to reduce erosion, requiring developers to plan for on-site sediment rates and revising and updating the county’s regulatory floodplain maps.
- Culpeper County addressed mitigation strategies for stormwater runoff through zoning ordinance policies requiring more trees to be preserved and planted in landscape designs
- Several jurisdictions upgraded and/or installed Reverse 911 systems to improve public safety communication during the period between the 2012 plan and the 2018 update
- The Town of Warrenton completed traffic signal coordination that previously caused significant problems for emergency vehicles trying to enter and exit the Town Police and Fire stations
- All localities in the region have made significant progress toward addressing Goal #5 related to emergency response training and public education related to hazard mitigation. While progress is noted, improvements may still be made especially in the area of public education.

Section 9: Plan Maintenance Procedures

The *Plan Maintenance Procedures* section discusses how identified mitigation strategies will be implemented by participating jurisdictions and how the Plan will be evaluated and updated over time. This section also discusses how the public will continue to be involved in the hazard mitigation planning process. This section was updated as part of the 2018 Hazard Mitigation Plan updates.

ADOPTION

The Rappahannock-Rapidan Regional Hazard Mitigation Plan is expected to be adopted by participating jurisdictions in early Fall 2018. All resolutions for adoption of the plan will be included in the appropriate plan appendix. A copy of all resolutions will be maintained on file with the Rappahannock-Rapidan Regional Commission, and each individual jurisdiction will maintain its own resolution with its records. Public comment was solicited during the drafting of the plan revision and prior to adoption by each participating jurisdiction. Local emergency management officials, planners, administrators, and/or RRRC staff were available to discuss the plan at all public meetings.

IMPLEMENTATION

Jurisdictions participating in this Plan identified specific mitigation actions as prescribed in the Mitigation Strategy section. Strategies for each participating jurisdiction may be implemented at the discretion of each jurisdiction, and opportunities for cross-jurisdictional collaboration are also possible for mitigation actions targeting training, public awareness and education, and prevention.

Ultimately, funding is the critical factor impacting the implementation of mitigation strategies. Low-cost strategies or those strategies with existing funding through local Capital Improvements Programs or other funding sources offer opportunity for jurisdictions to make immediate progress in implementation. Projects with higher costs, or those requiring significant additional planning prior to advancement, may be achievable with strong local and/or regional support.

Each action has been assigned to a specific person or local government office that is responsible for implementing that specific action. Since each jurisdiction has specific mitigation actions that will be implemented, they have adopted their locally specific Mitigation Strategy section of the Plan separately. Consequently, individual jurisdictions may update that specific section of the Plan without meeting with the remainder of the R-RRC Hazard Mitigation Committee. Separate adoption of locally specific actions is required so that each jurisdiction is not responsible for the action(s) of the jurisdiction involved in the planning process. Separate adoption of locally specific actions also allows for each jurisdiction to retain flexibility over its prioritized strategies within the overall plan in between each five-year update of the Plan.

A review of the progress on the strategies identified in the previously adopted plan is included in the Appendix. In general, most localities have made progress on mitigation strategies, through ordinance reviews, floodplain reviews and management and GIS implementation and development.

For each identified action, potential funding sources have also been listed that may be used when the jurisdiction begins seeking funding for implementation of the action. These funding sources are not meant to be the only potential funding sources or strategies, but do provide an initial starting point for new projects, as well as projects already in progress. Participating jurisdictions also had the option of identifying new strategies as part of the plan update process, all of which are included in the appendix.

PLAN INTEGRATION

It will be the responsibility of each participating jurisdiction to determine additional implementation procedures beyond their Mitigation Action Plan. This includes integrating the Plan into other planning documents, processes or mechanisms such as comprehensive or capital improvement plans, where appropriate.

Since local adoption of the original plan in 2005, many jurisdictions have incorporated mitigation strategies and principles into their Emergency Operations Plans, Comprehensive Plans, and other local planning processes. As part of the 2018 plan update, each participating jurisdiction included a strategy to review the Hazard Mitigation Plan and identified strategies as part of its regular review and update of other jurisdictional plans. Progress on these strategies will be tracked as part of future updates to the Hazard Mitigation plan.

For further integration into existing planning documents, each participating jurisdiction may create a process by which the requirements of this hazard mitigation plan will be incorporated into other local plans. During the planning process for new and updated local planning documents, such as the comprehensive plan, capital improvements plan, or emergency management plan, the local planner or emergency management coordinator should provide a copy of the hazard mitigation plan to each respective advisory committee member. The local planner or emergency management coordinator should recommend to those persons making revisions to the afore noted plans that the goals and strategies of the new or revised planning documents should remain consistent with the goals and strategies of the hazard mitigation plan and not contribute to increasing the effects of natural hazards within the community.

As referenced above, between the initial plan development and subsequent revisions, several jurisdictions successfully modified existing plans and ordinances to incorporate previously identified mitigation strategies into other long-term planning and emergency management efforts. Local officials, planners and emergency management personnel should continue to advocate for review and inclusion of identified mitigation strategies into relevant local plans and ordinances, as necessary.

EVALUATION AND ENHANCEMENT

Periodic revisions and updates of the Plan are required to ensure that the goals and objectives of the Plan are kept current, taking into account potential changes in hazards vulnerability and mitigation priorities. More importantly, revisions may be necessary to ensure that the Plan is in full compliance with federal regulations and state statutes. This portion of the Plan outlines the procedures for completing such revisions and updates.

FIVE-YEAR PLAN REVIEW

The Plan will be reviewed every five (5) years to determine whether there have been any significant changes in the Rappahannock-Rapidan region that might affect the Plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques, and changes to federal or state legislation are examples of changes that may affect the condition of the Plan. This review also gives community officials an opportunity to evaluate those actions that have been successful and to explore the possibility of documenting those losses avoided.

The five-year update will be coordinated by RRRC. At minimum, the five-year plan review should incorporate any local amendments completed during the interim period between plan updates, and should be submitted to the Virginia Department of Emergency Management and Federal Emergency Management Administration for formal review. However, RRRC should continue to seek planning grant funds (Pre-Disaster Mitigation and/or Hazard Mitigation Grant Program) to ensure a full review and update of the plan every five years. Planning grant applications should be made two years in advance of the five-year horizon, and plan review and updates procedures should commence no later than one year in advance of the five-year horizon.

PLAN MONITORING

RRRC will be responsible for the continued coordination of the monitoring of this plan. RRRC should coordinate with the representatives identified from each participating jurisdiction (or the local Chief Administrative Officer, in case of position turnover) on an annual basis, at minimum, to collect annual updates on implementation progress or other factors impacting the jurisdiction's hazard mitigation capabilities. The yearly reports should coincide with the anniversary of the approval date of this plan, or other annual benchmark date as identified by the plan update steering committee. The annual review process should also be used as an opportunity to note any critical local and regional projects to be prioritized by the state, and as an opportunity to identify any needs training or technical assistance to enhance mitigation capacity across the region. Once completed, the annual status update will be communicated to FEMA, VDEM, and the Regional Commission board.

RRRC staff should communicate and participate regularly with various local and regional stakeholders in the period between plan updates, including the Regional Emergency Coordinators group that meets bi-monthly (as of 2018), the RRRC Land Use & Environment committee that meets quarterly (as of 2018).

The Emergency Management Coordinator will also be responsible for coordinating the yearly reporting activities of the towns within their respective counties and for coordinating the reconvening of the appropriate Hazard Mitigation Committee members for future meetings.

If any of the counties or towns that participated in this planning effort do not wish to participate in future updates of the Plan, they must notify RRRC staff in writing prior to any application for funding for planning assistance in support of a five-year plan review and update process.

DISASTER DECLARATIONS

Following a disaster declaration, the Plan will be reviewed by each affected jurisdiction to reflect lessons learned or to address specific circumstances arising from the changing conditions surrounding subsequent disaster events. Following local review, proposed changes to the Mitigation Strategies can be adopted by each jurisdiction, while broader changes to the 2018 Hazard Mitigation Plan will be discussed by the RRRC Board, Hazard Mitigation Committee, Regional Emergency Coordinators and other stakeholders as part of the ongoing maintenance of the Plan in between five-year updates. RRRC will maintain proposed changes to the entire plan document for use in the subsequent five-year Plan update process.

REPORTING PROCEDURES

The results of the five-year review should be summarized in a report prepared for the RRRC Board of Directors. The report will include an evaluation of the effectiveness and appropriateness of the Plan, and will recommend, as appropriate, any required changes or amendments to the Plan. The report will also include an evaluation of implementation progress for each of the proposed mitigation actions, identifying reasons for delays or obstacles to their completion.

LOCAL PLAN AMENDMENT PROCESS

Participating counties and towns can amend their Mitigation Actions at any time. An amendment to the Plan should be initiated only by the local governing body, either on its own initiative or upon the recommendation of the chief elected official, planner, or emergency management officials.

Minor revisions and clarifying changes can be made by the local governing body without going through the public participation and adoption process. Examples of these changes include:

- Minor spelling and grammatical corrections; and
- Minor corrections to statistics, dates and calculations.

The local point of contact for each jurisdiction should inform RRRC staff of any amendments to the mitigation strategies and/or minor revisions at the time of amendments, and should include such amendments during each annual reporting process.

CONTINUED PUBLIC INVOLVEMENT

Public input was an integral part of the completion of the original RRRC Regional All-Hazards Mitigation Plan, and the two plan revisions completed in 2012 and 2018. As is the case with any officially adopted plan or ordinance, any significant change to this Plan shall require a public hearing and all meetings involving the hazard mitigation committee, including five-year update meetings and interim meetings, will be advertised and accessible to the public.

All relevant project documents, including the 2005 plan and identified mitigation strategies, the 2012 plan update, and the 2018 plan revisions and meeting materials are available via the Rappahannock-Rapidan Regional Commission website.

Other efforts to involve the public in the maintenance, evaluation and revision process will be made as necessary. These efforts may include:

- Advertising meetings of the Hazard Mitigation Planning Committee to media outlets within the Rappahannock-Rapidan region;
- Utilizing local media to update the public of any maintenance or periodic review activities taking place;
- Utilizing city and county Web sites to advertise any maintenance or periodic review activities taking place; and
- Making copies of the plan available at County or Town offices and/or public libraries, as necessary
- Utilizing social media to inform the public of the Hazard Mitigation plan and the need for input and review by the public.