RAPPAHANNOCK-RAPIDAN MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

2012 UPDATE

Rappahannock-Rapidan
REGIONAL COMMISSION

IN COORDINATION WITH:

CULPEPER COUNTY	TOWN OF CULPEPER
FAUQUIER COUNTY	TOWN OF MADISON
MADISON COUNTY	TOWN OF ORANGE
ORANGE COUNTY	TOWN OF REMINGTON
RAPPAHANNOCK COUNTY	TOWN OF WARRENTON

TABLE OF CONTENTS

PREPARED WITH FUNDING FROM THE VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT AND THE FEDERAL EMERGENCY MANAGEMENT AGENCY

INTRODUCTION

BACKGROUND

On October 30, 2000, the Disaster Mitigation Act of 2000, DMA2K, was signed into law. Thus was established the requirement that local and state governments develop and adopt Hazard Mitigation Plans (HMPs) 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. In accordance with DMA2K, the 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.

Hazard Mitigation:
Any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards.

The Rappahannock-Rapidan Regional Hazard Mitigation Plan Update 2011 is a continuation of the planning effort begun in 2004 and is an effort among the participating jurisdictions to mitigate the impacts of natural hazards in the Rappahannock-Rapidan region. In developing the 2011 Plan Update, certain elements of the original plan were retained. Irrelevant and/or outdated information was summarized for reference or removed. The goals, actions, and strategies included in the initial plan have been re-evaluated and their status updated as completed, deleted, deferred or on-going.

Since the adoption of its first hazard mitigation plan in 2005, based on the 2000 census, the Rappahannock-Rapidan region has experienced significant population growth along with associated changes in demographics, service demands, transportation needs, and economic development. This plan provides updated mitigation strategies designed to meet the needs of this changing region.

Rappahannock-Rapidan Region Population: 2000-2010*			
County	**2000**	**2010**	**Population Change (%)**
Culpeper	34,262	46,689	36.27%
Fauquier	55,139	65,203	18.25%
Madison	12,520	13,308	6.30%
Orange	25,881	33,481	29.37%
Rappahannock	6,983	7,373	5.6%
R-R Region	**134,785**	**166,054**	**23.20%**

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

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 justify the process of determining appropriate hazard mitigation actions. The 2011 Rappahannock-Rapidan Regional HMP update process involved a comprehensive re-evaluation of all sections of the previous plan. This document includes:

- A detailed characterization of natural hazards that historically affect the Rappahannock-Rapidan region;
- A risk assessment analysis that describes potential losses to physical assets, people and operations;
- Goals and objectives developed by each member jurisdiction;
- Strategies and actions that will guide mitigation activities; and
- A detailed procedure for implementing and monitoring the plan.

PURPOSE

As a comprehensive strategy designed to reduce or eliminate the impacts of natural hazards in the region served by the R-RRC, 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.

SCOPE

This plan focuses on those hazards determined to be of high and moderate risk as identified by a hazard risk assessment conducted in the five-county region. This approach allows participating jurisdictions to prioritize planning strategies and mitigation actions verified by quantifiable characterizations of hazard risk and vulnerability.

A review of past natural disasters in the Rappahannock-Rapidan region identifies the following natural hazards as posing significant risks to member jurisdictions:

- Floods
- Hurricanes and Tropical Storms
- Severe Thunderstorms and Hail
- Tornadoes
- Wildfire, Urban Interface Fire
- Drought/Extreme Heat
- Winter Storms
- Landslides

In addition to identifying and describing these hazards, the plan analyzes the Rappahannock-Rapidan region's vulnerability to each. The physical characteristics of each hazard, along with its potential impact on the region's population, built and natural environments, and social and economic infrastructure are addressed in the Vulnerability Assessment. Goals and strategies for hazard mitigation and risk reduction are identified, as is a mechanism for plan maintenance.

AUTHORITY

The 2011 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. The Rappahannock-Rapidan Region Multi-Jurisdictional Hazard Mitigation Plan 2011 Update, meets all required elements, including:

- Documentation of the plan preparation process, including participants;
- Documentation of public involvement;
- A regional risk assessment that includes:

- Identification of the hazards likely to affect the area, noting data limitations and providing an explanation for eliminating hazards from further consideration;
  - A discussion of past events and descriptions of their severity and resulting effects;
  - A description of the local vulnerability to the described hazards in terms of the types and numbers of buildings, infrastructure, and critical facilities located in the region;
  - An evaluation of potential losses, in dollars, to identified vulnerable structures and a description of evaluation methods used; and
  - A determination of vulnerability to guide future land-use decisions.
- A hazard mitigation strategy that includes:
  - Goals to reduce or avoid vulnerabilities to the identified hazards;
  - A range of specific mitigation actions and projects to be considered;
  - An action plan detailing prioritization, implementation and administration of proposed actions by local jurisdictions. Prioritization must reflect a cost/benefit analysis.
  - Jurisdiction-specific action items within multi-jurisdictional plans;
- Documented participation in the planning process by all units of government included in the plan.
- Provisions for reviewing, monitoring and evaluating the progress of the plan's implementation, including consideration for the required five-year update and re-approval.
- Documentation of formal adoption by each unit of government included in the plan.

This plan was developed with input and assistance from the Virginia Department of Emergency Management and is consistent with the requirements of that agency.

The following table reflects the jurisdictions that participated in the development of the 2004 plan and the 2011 update:

JURISDICTION	2004 PARTICIPATION	PLAN ADOPTION DATE	2011 PARTICIPATION
Culpeper County	Yes	April 5, 2005	Yes
Fauquier County	Yes	October 14, 2004	Yes
Madison County	Yes	March 8, 2005	Yes
Orange County	Yes	February 22, 2005	Yes
Rappahannock County	Yes	February 7, 2005	Yes
Town of Culpeper	Yes	March 8, 2005	Yes
Town of Gordonsville	No	-	No
Town of Madison	Yes	February 3, 2005	Yes
Town of Orange	Yes	February 28, 2005	Yes
Town of Remington	Yes	January 24, 2005	Yes
Town of The Plains*	No	-	*Through County**
Town of Washington*	No	-	*Through County**
Town of Warrenton	Yes	March 8, 2005	Yes

*The Town of The Plains and the Town of Washington have limited full-time staff and work with Fauquier and Rappahannock counties, respectively, on long-term planning initiatives such as Mitigation planning.

PLAN OUTLINE

The Rappahannock-Rapidan Regional Hazard Mitigation Plan Update 2011 is organized as follows:

- Section 1: Introduction
- Section 2: Planning Process – Plan Requirements, Description of Planning Process, Plan Update participants
- Section 3: Regional Profile – Profile of Rappahannock-Rapidan region
- Section 4: Hazard Identification – Identification and description of Hazards affecting the Rappahannock-Rapidan region
- Section 5: Hazard Analysis – Description of historical hazard occurrences in the Rappahannock-Rapidan region
- Section 6: Vulnerability Assessment – Assessment of potential impacts of hazards in the Rappahannock-Rapidan region
- Section 7: Capability Assessment – Assessment of capability of jurisdiction's to develop and implement mitigation strategies and identify realistic goals and opportunities for jurisdiction response
- Section 8: Mitigation Strategy – Overview of relevant mitigation strategies and projects
- Section 9: Plan Maintenance – Outline of future mitigation planning efforts and plan update procedures
- Appendix A: Local Mitigation Actions
- Appendix B: FEMA Crosswalk
- Appendix C: Supporting Documentation
- Appendix D: Plan Adoption Resolutions
- Appendix E: Hazard Identification (Human Caused Hazards)
- Appendix F: Vulnerability Assessment (Human Caused Hazards)

PLANNING PROCESS

In developing the Rappahannock-Rapidan Regional Hazard Mitigation Plan 2012, certain elements of the original plan were retained. Irrelevant and/or outdated information was summarized for reference or removed. The goals, actions, and strategies included in the initial plan have been re-evaluated and their status updated as completed, deleted, deferred or on-going.

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, the Disaster Mitigation Act of 2000 (DM2K) 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 five 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), Flood Mitigation Assistance Program (FMA), Repetitive Flood Claims Program (RFC), and Severe Repetitive Loss Program (SRL). 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 five 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/library/viewRecord.do?id=4225.

- **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.
- **FEMA/NFIP Severe Repetitive Loss Program (SRL):** The SRL program was authorized by the Flood Insurance Reform Act of 2004 to provide funding to reduce or eliminate the long-term risk of flood damage to residential structures under the NFIP which have suffered repetitive losses. SRL properties have at least four NFIP claim payments over $5,000, with at least two of the claims within a 10 year period. SRL properties are also residential structures that have at least two separate claim payments made within a 10 year period with the cumulative amount of the building portion of the claims exceeding the value of the property.
- **FEMA/NFIP Repetitive Flood Claim Program (RFC):** The RFC program was authorized by the Flood Insurance Reform Act of 2004 to assist States and communities reduce flood

damages to properties that have at least one NFIP claim payment. Various hazard mitigation activities are eligible including acquisition, elevation, and dry flood-proofing of residential structures.

PLANNING TEAM ORGANIZATION

The Rappahannock-Rapidan Regional Hazard Mitigation Plan 2012 included participation by planning and engineering staff from participating counties and towns, emergency management officials from participating counties and towns, staff members from the Rappahannock-Rapidan Regional Commission, and state agency officials. Participants in the planning process also included: 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 Appendix C. 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 Rappahannock-Rapidan Regional Hazard Mitigation Plan 2012 is a revision of the 2005 Plan, approved by FEMA in December 2004 and adopted by jurisdictions in 2005.

The 2012 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 2011 Plan Update

The Rappahannock-Rapidan Regional Commission coordinated the updates to the Regional Hazard Mitigation Plan 2012, with assistance from FEMA and the Virginia Department of Emergency Management.

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 to be included as addenda to 2005 Mitigation Action Plans.

Three planning team meetings were held in 2010 to kickoff the process of updating the plan. All meetings were held at the Rappahannock-Rapidan Regional Commission offices and were publically advertised and open to the public.

February 23, 2010: RRRC Regional Hazard Mitigation Plan Update Kickoff Meeting

- Hazard Mitigation Overview
- Data Collection Guide Review and Format
- Project Schedule
- Outline of jurisdictional responsibilities

April 20, 2010: RRRC Regional Hazard Mitigation Plan Update Meeting

- Hazard Identification Review
- Unique Hazard Identification Review
- Hazard History Update & Review

July 13, 2010: RRRC Regional Hazard Mitigation Plan Update Meeting

- Critical Facilities/Asset Inventory Review
- Demographic Analysis Update & Review
- Mitigation Action & Strategy Review

Throughout 2011 and 2012, local and regional staff completed updates to the hazard identification and analysis, vulnerability analysis, capability assessment and mitigation action strategies sections of the plan. Regional Commission staff also reviewed the man-made hazard appendices from the 2005 RRRC Regional Hazard Mitigation Plan as part of the update process.

During the plan update process, a publically 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 Appendix C: Supporting Documentation.

Following coordinated reviews with each of the participating jurisdictions, Rappahannock-Rapidan Regional Commission staff developed the draft 2012 RRRC Regional Hazard Mitigation Plan in March 2012. The draft plan was made available for public review and comment for a three week period ending on April 6, 2012 and a review meeting was held on April 13, 2012 with the Hazard Mitigation planning team. 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.

No public comments were received during the public comment period.

Comments received from Hazard Mitigation stakeholders after the release of the draft plan were incorporated, as applicable, into the draft 2012 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 2012 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 one final opportunity to comment and suggest possible revisions.

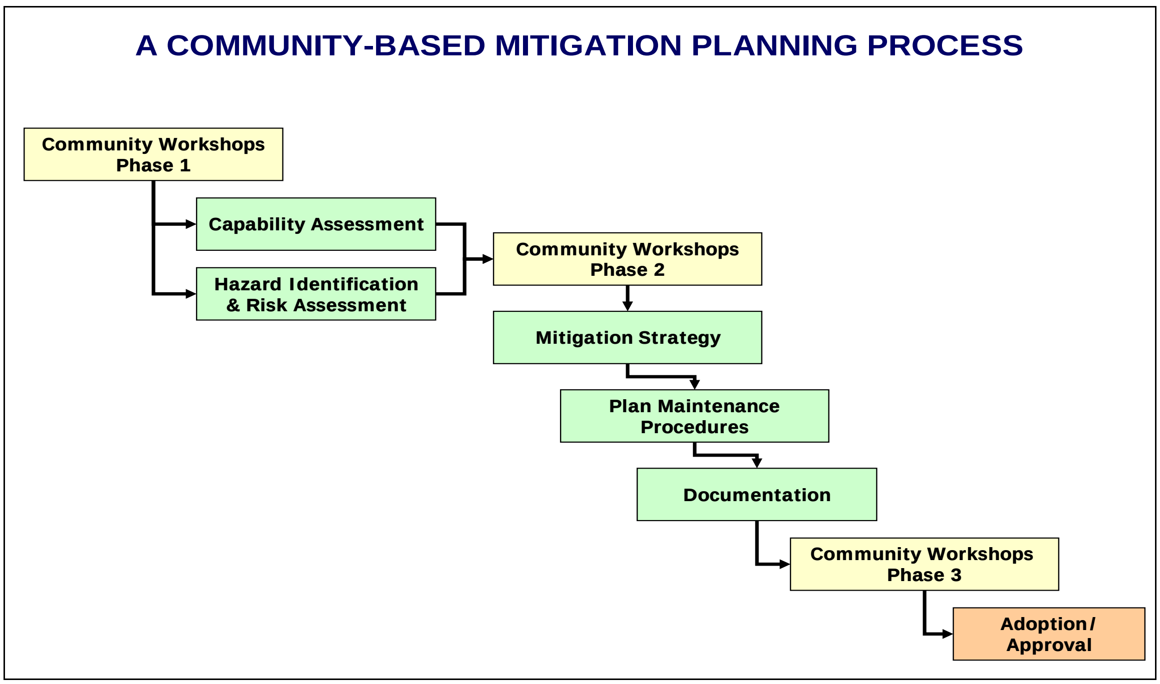
Development of 2005 Plan

The following section, describing the planning process for the development of the 2005 Rappahannock-Rapidan Regional Hazard Mitigation Plan, is included for reference below:

The planning process followed a widely recognized approach that meets the requirements of FEMA and the Virginia Department of Emergency Management. A Local Mitigation Plan Crosswalk, found in Appendix B, provides a summary of federal and state standards of acceptability and notes where each requirement is met within the Plan.

The planning process included nine (9) major steps that were completed over the course of 10 months. The steps are displayed in **Figure 2.1** and discussed below. First, the primary components of the Plan will be discussed, followed by a description of the three community workshops.

Figure 2.1
A Community-Based Mitigation Planning Process



The *Community Profile*, located in Section 3, describes the makeup of participating counties and municipalities, including prevalent geographic, demographic and economic characteristics. In addition, building characteristics and land use patterns are discussed. This baseline information helps to provide a snapshot of the planning area and thereby assist R-RRC and regional officials recognize those factors that ultimately play a role in describing community vulnerability.

The *Risk Assessment*, found in Sections 4 through 6, describes and analyzes the natural and human-caused hazards present within the Rappahannock-Rapidan Region. This analysis utilizes historical data on past hazard occurrences, and establishes hazard profiles and a hazard risk ranking based on hazard frequency, magnitude and impact. The FEMA HAZUS® loss estimation methodology, combined with the use of existing historical hazard data, was used to conduct the assessment. The findings of the risk assessment enable communities to focus their efforts on those structures or planning areas facing the greatest risk.

The *Capability Assessment*, found in Section 7, provides a comprehensive examination of participating jurisdictions' capacity to implement meaningful mitigation actions and identifies existing opportunities for program enhancement. Capabilities addressed in this section include staff and organizational capability, technical capability, policy and program capability, fiscal capability, legal authority and political willpower. Information was obtained through the use of detailed questionnaires and the analysis of existing plans, ordinances and relevant documents. The purpose of this assessment is to identify any existing gaps, weaknesses or conflicts in programs or activities that may hinder mitigation efforts, or to identify those activities that can further the overall mitigation strategy.

The *Community Profile*, *Risk Assessment* and *Capability Assessment* are considered background studies and form the basis for developing, adopting and implementing the *Mitigation Strategy* found in Section 8. The *Mitigation Strategy* is intended to be both strategic (based on long-term goals) and functional (tied to short-term actions). In order to ensure that the *Mitigation Strategy* is effectively implemented over time, *Plan Maintenance Procedures* have been established and are found in Section 9.

Community Meetings and Workshops

The creation of the Plan required a series of meetings and workshops, designed to collect data, inform counties and local governments of the *Risk Assessment* and *Capability Assessment* findings, develop mitigation actions, and involve the public. The series of meetings and workshops prompted continuous input and feedback from R-RRC officials, local officials and concerned citizens throughout the planning process. The meetings and community workshops are described below.

Initial Project Kickoff Meeting

The project kickoff meeting was held on January 15, 2004 with the staff of the Rappahannock-Rapidan Regional Commission, staff members from project consultants PBS&J and URS and members of the participating counties and municipalities. Discussions focused on the overall project approach, emphasizing the steps necessary to meet the requirements of the Disaster Mitigation Act of 2000. First, a description of the hazard mitigation planning process was presented, explaining each step and the type of data that would be required to develop the plan. Specific tools, including the *Data Acquisition and Categorization Matrix*, used to collect necessary risk assessment information, and the *Capability Assessment Survey* were described. The *Public Participation Survey* was also introduced. Next, the project timeline was presented. Finally, roles and responsibilities were assigned to members of the planning team, including R-RRC officials, municipal governments and project consultants.

Specific roles for the parties involved in the planning process included:

Rappahannock-Rapidan Regional Commission

- Project Management
- Coordination
  - Developing and monitoring inter-local agreements;
  - Meeting and workshop logistics; and
  - Data collection and exchange.
- Communications
  - Group e-mail distribution; and
  - Web site postings.
- Data
  - Providing demographic profiles for the RRRC region;
  - Providing hazard identification and risk assessment data; and
  - Disseminating *Local Capability Assessment Questionnaires* to counties and participating municipalities.
- Documentation

PBS&J & URS

- Technical Assistance
- Data Collection
- Analysis
  - Hazard Identification and Risk Assessment;
  - Capability Assessment; and
  - Mitigation Strategy Development.
- Community Workshops/ Public ParticipationMonthly Progress Reports

County and Municipal Governments

- Coordination
  - Establish single point of contact;
  - Attend community workshops; and
  - Solicit public input/involvement.
- Data
  - Hazard Identification;
  - Capability Assessment; and
  - Completed Hazard Mitigation Programs.
- Mitigation Strategy
  - Develop goals and mitigation actions; and
  - Establish local implementation procedures (responsibility and timeline).
- Plan adoption by governing body

Finally, critical "next steps" were discussed, including the need for ongoing coordination throughout the planning process. Specific issues included the need to gather and analyze additional data, such as information associated with human-caused hazards. Future meetings were discussed, including the first planning workshop with each county and participating municipalities and the second workshop that involved the presentation of the risk and capability assessment findings.

It was decided that immediately following the second planning workshop, separate brainstorming sessions would be conducted in order to assist each county and participating town formulate regional goals and their jurisdiction-specific mitigation actions. It was also decided that evening public meetings would be held following each workshop to invite public comment on the findings of the risk and capability assessments and solicit input regarding hazard concerns and potential mitigation actions that could be added to those identified by participating county and town officials. Once a draft Plan was completed, it would be presented to local officials and the general public for further comment. The comments would be incorporated and a final draft Plan would be prepared for submittal to the state and FEMA for their review and approval.

Second Planning Workshop

The second regional planning workshop was held on April 29, 2004, at the Rappahannock-Rapidan Regional Commission's Board Room. During this meeting, the PBS&J staff presented the preliminary findings of the *Risk Assessment* and *Capability Assessment* to county and municipal officials. Providing officials with a more thorough understanding of hazard risks and the capabilities present to address them set the stage for the next step in the process—the creation of specific mitigation actions designed to reduce future impacts.

Table 2.1
Workshop Information

Meeting	Location	Date
Kickoff Meeting	R-RRC Board Room	January 15, 2004
Mitigation Strategy Workshop	R-RRC Board Room	April 29, 2004

Following the presentation of the risk assessment findings, an interactive session was held to address questions and discuss potential concerns. In addition, each workshop attendee was issued a survey form entitled, "*Identification of Hazards Unique to Individual Jurisdictions*" designed to capture data on hazards not identified in the *Risk Assessment* presentation. Next, the *Capability Assessment* findings were presented. Participating communities that had not submitted surveys to R-RRC prior to the workshop were encouraged to do so as soon as possible.

An interactive brainstorming session was conducted in the afternoon with all workshop attendees. A "cardstorming" technique was used to begin building general countywide consensus on the mitigation goals for the Hazard Mitigation Plan. Attendees were asked to identify specific mitigation actions that their county or town could undertake to help them become less vulnerable to identified hazards. Each jurisdiction was encouraged to keep their existing capabilities in mind, in order to develop feasible mitigation actions and recommend specific improvements in existing programs.

Workshop participants were asked to spend 30 minutes discussing possible mitigation actions, including policies or projects, with other representatives from their jurisdiction. Following these discussions, individuals were instructed to write down specific mitigation actions on adhesive cards. The cards were then posted on the wall in order for all participants to review and discuss. Community officials were encouraged to elaborate upon each of their proposed mitigation actions. The discussion allowed individuals to clarify their thoughts and recognize similarities and differences across mitigation actions.

Next, the group sought to build consensus on the categorization of each proposed mitigation action. Following a brief review of the index cards placed on the wall, the workshop participants began to arrange the mitigation actions into columns that represented separate mitigation categories. Once categorized, each column was labeled by the group and later transformed into the goal statements found in Section 6. The mitigation actions identified during the cardstorming exercise were grouped into the following categories:

- Improve and update data
- Policy
- Planning
- Structural Projects
- Training
- Education and Outreach
- Evacuation

It was explained to county and municipal officials that following this workshop, they were expected to go back to their respective jurisdictions and convene with appropriate officials to identify additional mitigation actions. These actions, and those identified in the cardstorming exercise, were to be filled out using Mitigation Action Worksheets, provided by R-RRC.[1] Once completed, the worksheets were returned to R-RRC and incorporated into the Plan. Finally, the existing actions were reviewed relative to identified hazard vulnerabilities and local capabilities. Based on this review, additional mitigation actions were suggested by the planning team. Proposed actions were derived from an extensive listing of pre-drafted mitigation measures, referred to as the *Mitigation Policy Matrix*. This approach, emphasizing three distinct phases (cardstorming, in-house mitigation action identification, and expert input via the Mitigation Policy Matrix), was designed to provide each participating jurisdiction with a more comprehensive *Mitigation Strategy*.

In addition to the regional planning workshops, the Rappahannock-Rapidan Regional Commission, in coordination with FEMA, also hosted a HAZUS^{MH} training class in Warrenton, Virginia. The class was held May 13 and 14, 2004 at the Lord Fairfax Community College. HAZUS^{MH} is discussed in greater detail later in this Plan but is essentially a loss estimation modeling software that FEMA encourages to be used in developing hazard mitigation plans. The workshop was attended by various participants including members of academia, employees from other regional planning offices, and FEMA staff, among others.

[1] An example of the Mitigation Action worksheet is located in Section 6, *Mitigation Strategy*.

Involving the Public

An important component of this planning process involved public participation. Individual citizen and community-based input provided the entire planning team with a greater understanding of local concerns and increased the likelihood of successfully implementing mitigation actions by developing community "buy-in" from those directly affected by the decisions of public officials. As citizens become more involved in decisions that affect their safety, they are more likely to gain a greater appreciation of the natural hazards present in their community and take the steps necessary to reduce their impact. Public awareness is a key component of an overall mitigation strategy aimed at making a home, neighborhood, school, business or city safer from the potential effects of natural and human-caused hazards.

Public input was sought using four methods: 1) public meetings; 2) public participation survey; 3) Web site access; and 4) public library posting of the draft Plan. County-level public meetings were held at two stages of the planning process—following the second planning workshop and upon completion of the draft Plan. County-level public meetings were held to present the findings of the risk and capability assessments and garner input regarding hazard concerns and possible mitigation actions that could be included in the Plan. In many cases, citizens provided localized details of problematic hazards, particularly those that directly affected them.

Table 2.2
First Public Meetings[2]

Date	Location
April 28, 2004	Town of Orange
April 29, 2004	Town of Culpeper
April 29, 2004	Town of Warrenton

Citizen concerns were also captured through the use of a *Public Participation Survey*.[3] This tool was distributed to counties and participating municipalities as well as concerned citizens during public meetings. In addition, the survey was posted on the R-RRC public Web site. The survey asked a variety of questions that allowed the public a chance to weigh in on hazard mitigation issues within their communities[4]. A total of four surveys were collected from jurisdictions within the region. Comments were incorporated into the *Risk Assessment* and *Mitigation Strategy* sections of this Plan.

The second round of public meetings was held in conjunction with the adoption of the Plan. 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 one final opportunity to comment and suggest possible revisions.

[2] Sign-in sheets from the first round of public meetings can be found in Appendix C.
[3] A sample of the Public Participation Survey can be found in Appendix C.
[4] A summary of all the Public Participation Surveys received can be found in Appendix C.

Involving Stakeholders

A range of stakeholders was involved in the mitigation planning process. Stakeholder involvement was encouraged through the use of multiple planning workshops, public meetings, press releases, public notices and the notification of stakeholder groups. *Appendix C* contains information on how the public meetings were advertised. Any potential stakeholders were invited to attend and offer comments.

Multi-Jurisdictional Participation

The Rappahannock-Rapidan Region Multi-Jurisdictional All-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:

- Participate in mitigation planning workshops;
- Complete the Local Capability Assessment Survey;
- Identify completed mitigation projects, if applicable; and
- Develop and adopt a local Mitigation Action Plan, including county or town-level goals and mitigation actions.

Each county and town participated in the planning process and has developed local Mitigation Action Plans unique to their jurisdiction. Each county and town will adopt their Mitigation Action Plan separately. This provides the means for jurisdictions to monitor and update their Plan on a regular basis.

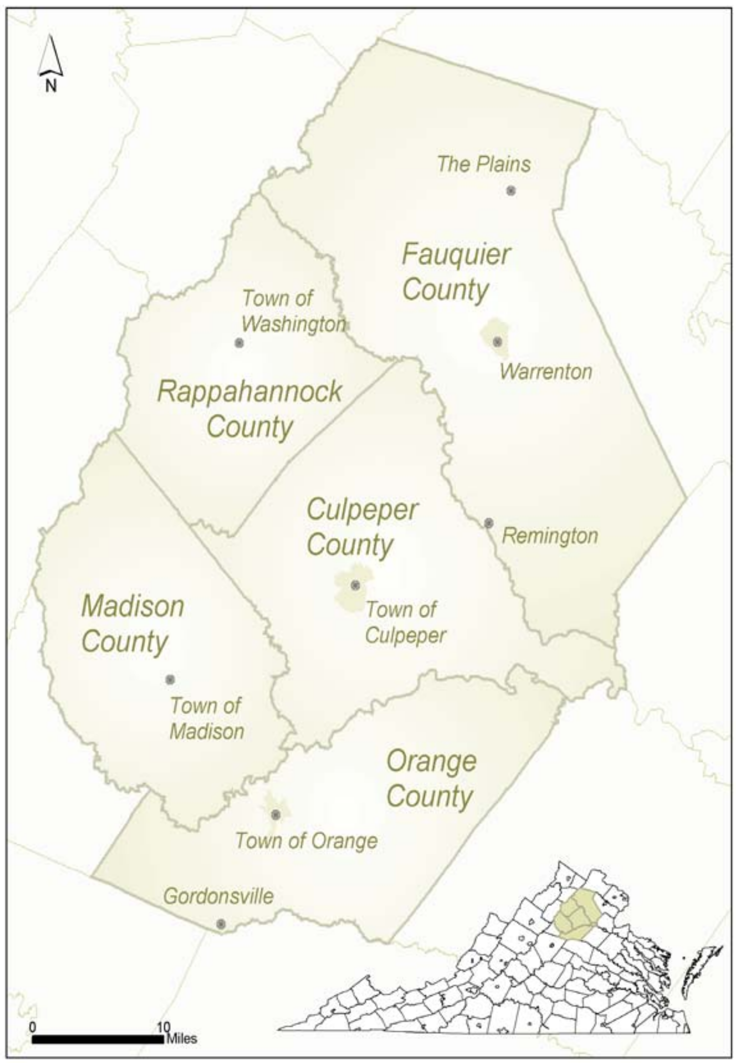
REGIONAL PROFILE

AREA AT A GLANCE

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 166,054 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.

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.

Figure 3.1
Overview of the Rappahannock-Rapidan Region



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

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

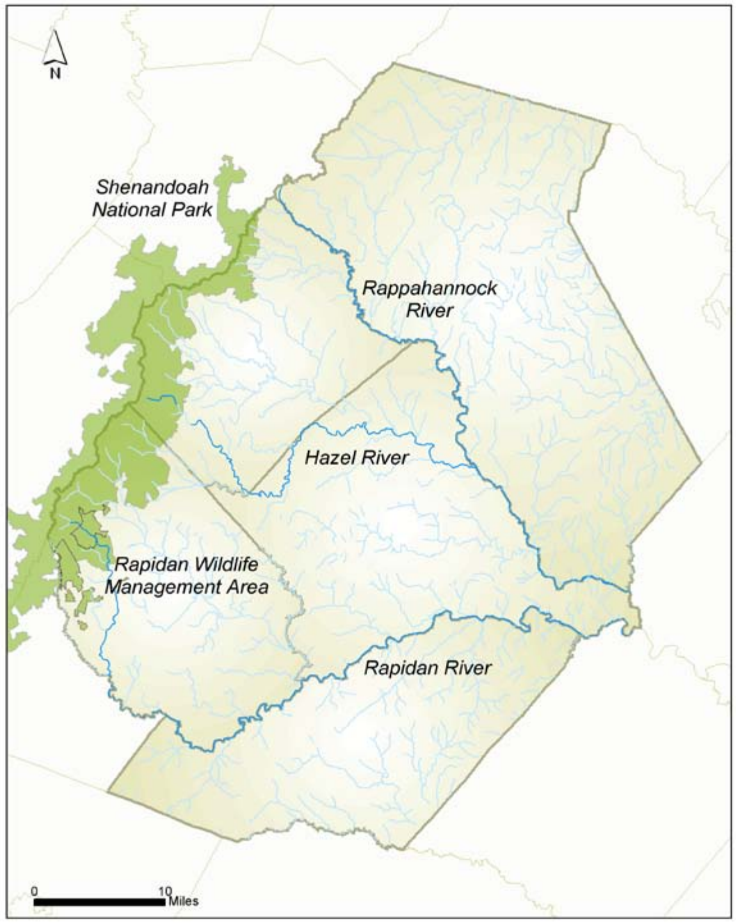
The counties of the Rappahannock-Rapidan region cover approximately 1,965 square miles. Fauquier County, at 660 square miles, is the largest and almost twice the size of the next largest county, Culpeper, at 389 square miles. Due to its size and proximity to the highly urbanized Northern Virginia area and Washington D.C., about 40 percent of the region's residents live in Fauquier County.

Table 3.1
County Populations and Densities

County	Area (square mi./acres)	2010 Population (U.S. Census)	Persons per square mile
Culpeper	389/248,960	46,689	120
Fauquier	660/422,400	65,203	99
Madison	327/209,280	13,308	41
Orange	355/227,200	33,481	94
Rappahannock	271/173,440	7,373	27
R-RRC Region	1,965/1,257,600	166,054	85

Source: Virginia Association of Counties, 2010 U.S. Census Bureau

Figure 3.2
Geography of the Rappahannock-Rapidan Region



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 villages and 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.

Because of significant changes in elevation from the mountainous headwaters' regions in the west to the flatter, gently rolling topography to the east, many streams are characterized as flashy, exhibiting increasing velocity and turbulence downstream and flooding locally during high rain events. On rare occasions, extreme rainfall in the region has resulted in severe landslides and significant flood damage.

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.

Figure 3.3
Major River Basins

LAND USE

Despite an increase in residential development, much of the land cover in the region remains forested or agricultural.

Table 3.2
Land Cover Percentages

Land Cover Type	Culpeper	Fauquier	Madison	Orange	Rappahannock
Pasture/Hay	40.3	42.9	29.2	32.3	29.2
Row Crops	3.3	1.9	3.4	2.3	0.6
Low Intensity Residential	1.8	2.4	1	1.4	0.7
Transitional	1.1	0.6	0	1.4	0
Deciduous Forest	30.5	33.7	43.1	36.9	44.3
Evergreen Forest	6.7	4	4	7.8	3.4
Mixed Forest	15.4	13.8	18.4	16.4	21.2
Woody Wetlands	0	0	0	0.6	0
Open Water	0	0	0	0.5	0
TOTAL	99.1	99.3	99.1	99.6	99.4

Source: 2008, National Land Cover Dataset, UVA Geostat Center, http://fisher.lib.virginia.edu/collections/gis/nlcd/

TABLE 3.3
FOREST LAND AREA BY COUNTY: *THOUSANDS OF ACRES*

COUNTY	ACCESSIBLE FOREST	NON-FOREST	OTHER	TOTAL
CULPEPER	109.7	120.7	6.4	236.7
FAUQUIER	203.2	218.1	5.5	426.9
MADISON	93.7	101.1	-	194.9
ORANGE	136.2	82.9	7.9	227.0
RAPPAHANNOCK	134.5	62.9	-	197.4
REGION	677.3	585.7	19.8	1,282.9

Source: Virginia Department of Forestry

Table 3.4
Number of Farms and Acres of Farmland
2002 to 2007 Comparison

COUNTY	# FARMS 2002	#FARMS 2007	FARM ACRES 2002	FARM ACRES 2007	% CHANGE IN FARM ACRES 2002-2007
CULPEPER	669	667	125,121	111,370	-11.0%
FAUQUIER	1,344	1,222	238,135	222,486	-6.7%
MADISON	531	564	102,874	102,757	-0.1%
ORANGE	486	518	104,879	104,606	-0.3%
RAPPAHANNOCK	443	416	78,483	65,084	-17.1%
REGION	**3,473**	**3,387**	**649,492**	**606,303**	**-6.6%**

SOURCE: 2007 U.S. CENSUS OF AGRICULTURE

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.

There are over 2,500 miles of primary and secondary roads in the region maintained by the Virginia Department of Transportation. 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.

Figure 3.4
Major Transportation Routes

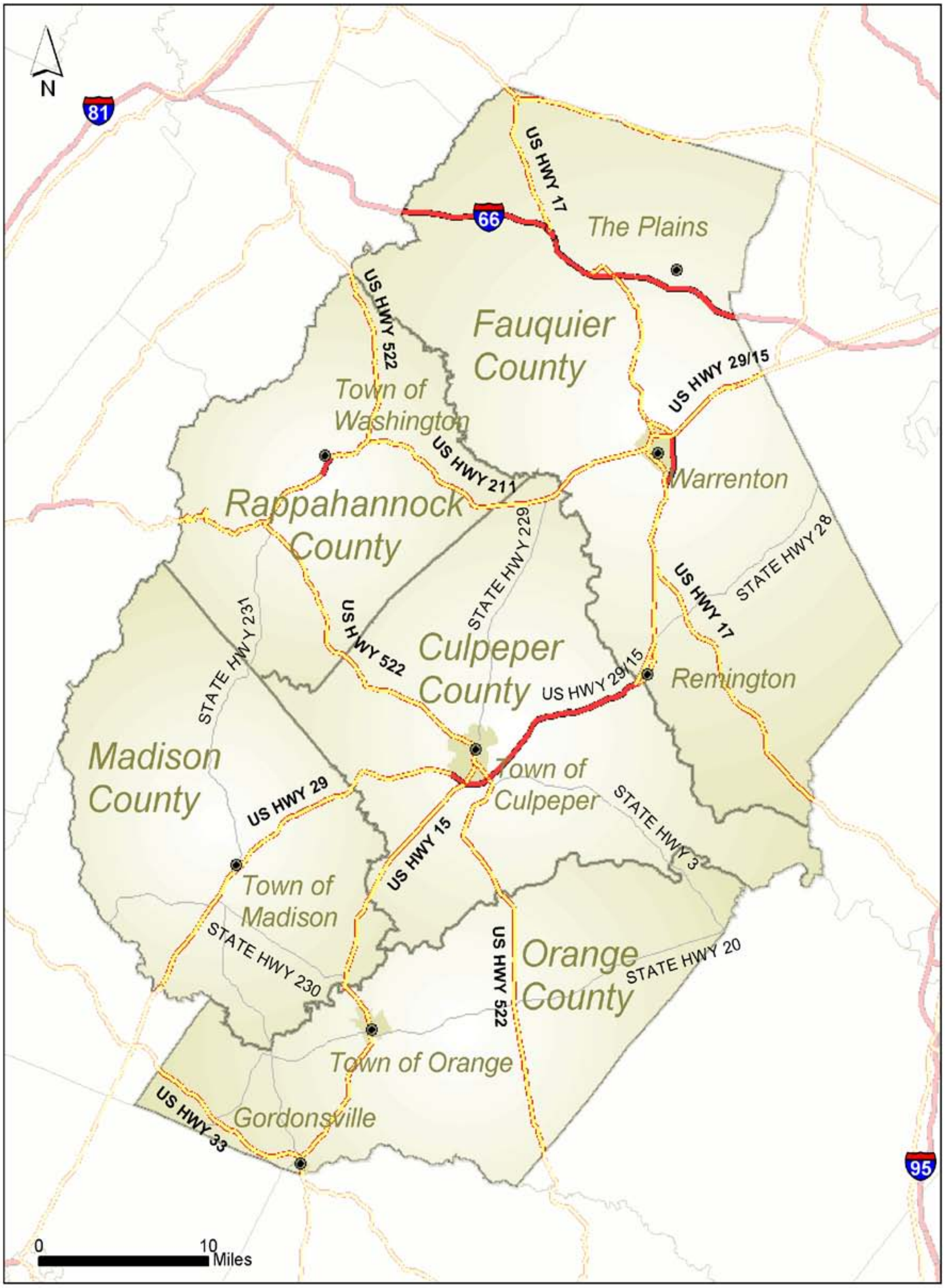


Table 3.5
Primary and Secondary Roadway Miles by County

Locality	Primary Miles	% of Region	Secondary Miles	% of Region	Total Miles
Culpeper	75.13	19.600032	484.68	22.89499	559.81
Fauquier	104.98	27.38775	802.08	37.01389	907.06
Madison	62.75	16.33053	306.23	14.13171	368.98
Orange	82.97	21.64567	355.13	16.38832	438.1
Rappahannock	57.48	14.99570	218.85	10.09936	276.33
Total	**383.31**	**100**	**2,166.97**	**100**	**2,550.28**

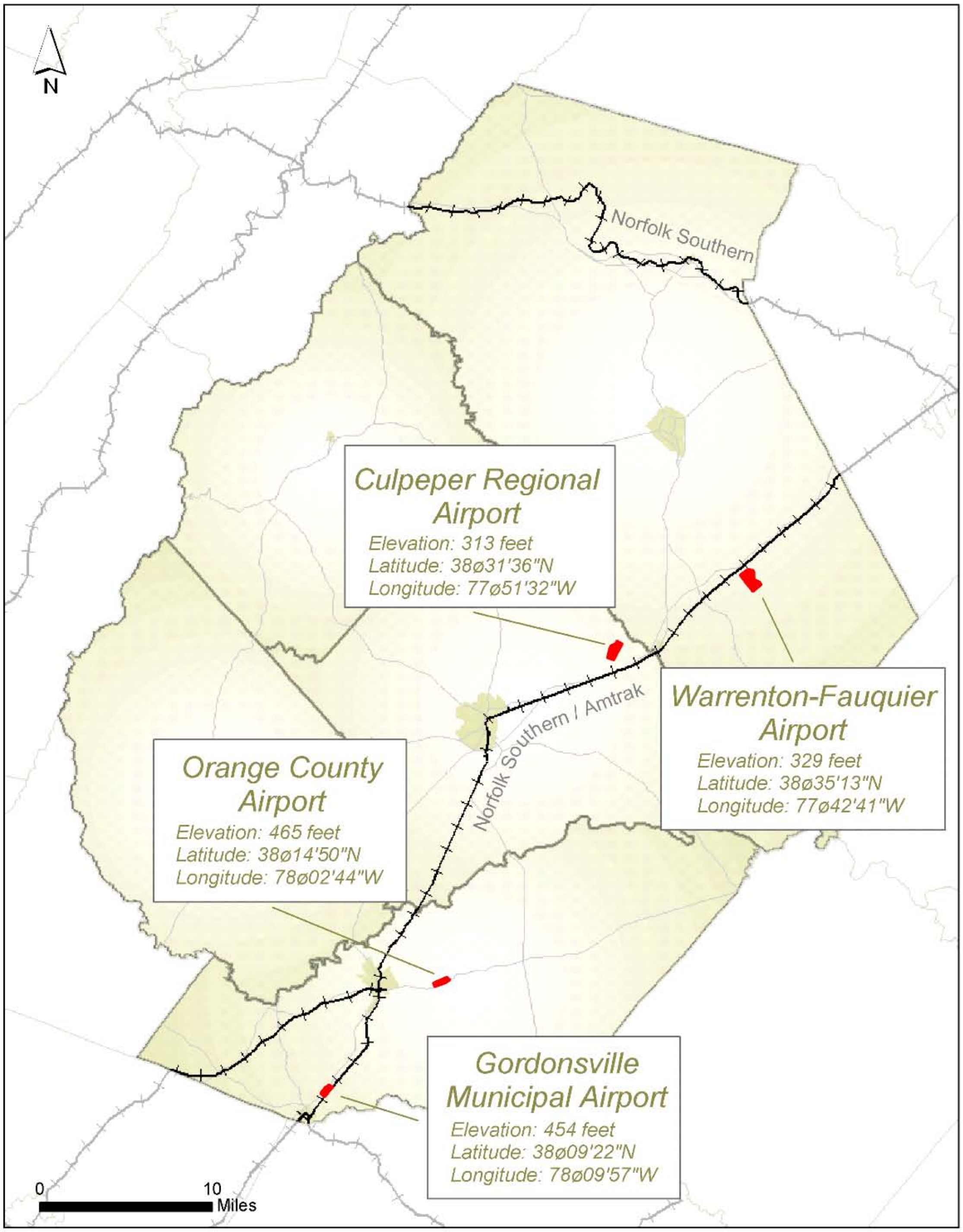
Source: 12/31/07 VDOT Mileage Tables, http://mileagetables.virginiadot.org/default.asp

Over the last decade, the Rappahannock-Rapidan region has experienced significant growth, most of which has occurred along the region's principal travel corridors (Fig. 3.4). 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, Virginia. Plans for expanding 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) and Warrenton-Fauquier Airport (KHWY) both average over 120 aircraft operations per day, while Orange County Airport (KOMH) and Gordonsville Municipal Airport average fewer than 30 aircraft operations per day.
(Source: www.airnav.com)

Figure 3.5
Alternative Transportation Modes



POPULATION

From 2000 to 2010 the population of the region grew from 134,785 to 166,054, an increase of 23.2% with most newcomers from Washington D.C. and the Northern Virginia metropolitan area. Despite this increase, the region's population density remains rather low at 85 individuals per square mile in 2010, slightly less than the national average of 87 persons per square mile and considerably less than that of the Commonwealth's 203 persons per square mile.

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 3.6). 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 3.6
Population Growth in the Region

Town	2000 Population	2010 Population	Percent Change	Population Change
Culpeper	9,664	16,379	69.48	6,715
Gordonsville	1,498	1,496	-0.07	-2
Madison	210	229	9.05	19
Orange	4,123	4,721	14.50	598
Remington	624	598	-4.17	-26
The Plains	266	217	-18.42	-49
Warrenton	6,670	9,611	44.09	2,941
Washington	183	135	-26.23	-48
County*	**2000 Population**	**2010 Population**	**Percent Change**	**Population Change**
Culpeper	34,262	46,689	36.27	12,427
Fauquier	55,139	65,203	18.25	10,064
Madison	12,520	13,308	6.29	788
Orange	25,881	33,481	29.36	7,600
Rappahannock	6,983	7,373	5.58	3,390
R-RRC Region	**134,785**	**166,054**	**23.20**	**31,269**
Virginia	7,079,048	8,001,024	13.02	921,976
Nation	281,424,602	308,745,538	9.71	27,320,936

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

Predictions indicate that population growth trends will continue across the region as they have been with most increases occurring in counties that are closest to Northern Virginia and nearby urban areas (**Table 3.7**).

Table 3.7
County Population Projections

County	2010 (U.S. Census)	2020	2030
Culpeper	46,689	61,255	75,221
Fauquier	65,203	83,319	107,168
Madison	13,308	15,624	17,222
Orange	33,481	42,021	50,732
Rappahannock	7,373	8,242	9,066
R-RRC Region	166,054	216,460	259,409

Sources: Virginia Employment Commission

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. Recent 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.

HOUSING

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. Over the past ten years, however, Culpeper and Orange counties have claimed the greatest rate of population growth along with a corresponding growth in number of housing units. It should be noted, however, that the number of building permits issued in the region has declined after spiking in the middle of the past decade.

Table 3.8
Number of Housing Units

County	2000 (U.S. Census)	2010 (U.S. Census)	% Change	Housing Unit Density (sq. mile)
Culpeper County	12,871	17,657	37.18	45.4
Fauquier County	21,046	25,600	21.64	38.8
Madison County	5,239	5,932	13.23	18.1
Orange County	11,354	14,616	28.73	41.2
Rappahannock County	3,303	3,839	16.23	14.2
R-RRC Region	**53,813**	**67,644**	**25.70**	**34.4**

Source: U.S. Census

The steep decline in the number of residential building permits issued (Table 3.9) and the definite drop in the average sales prices of existing homes(Table 3.10) further emphasize the regional repercussions of the world-wide recession.

Table 3.9
Residential Building Permits

County	2000	2004	2009
Culpeper County	334	1,428	57
Fauquier County	533	703	106
Madison County	106	112	42
Orange County	247	526	61
Rappahannock County	44	58	21
R-RRC Region	**1,264**	**2,827**	**287**

Source: 2010 RRRC Data Summary

Table 3.10
Average Residential Real Estate Selling Price

County	2005	2007	2009
Culpeper County	$343,641	$328,619	$196,883
Fauquier County	$507,939	$483,296	$325,500
Madison County	$296,475	$297,072	$217,622
Orange County	$307,256	$319,962	$203,096
Rappahannock County	$498,353	$401,297	$359,122
R-RRC Region	**$400,672**	**$391,517**	**$253,641**

Source: MRIS

EMPLOYMENT AND INCOME

Because of its proximity to Washington, D.C., the Rappahannock-Rapidan region has weathered the current recession better than most areas. Unemployment levels tend to be lower than those in other parts of the state and the nation. Within the region, unemployment historically tends to be higher in the towns than in the counties.

Figure 3.6
Regional Unemployment

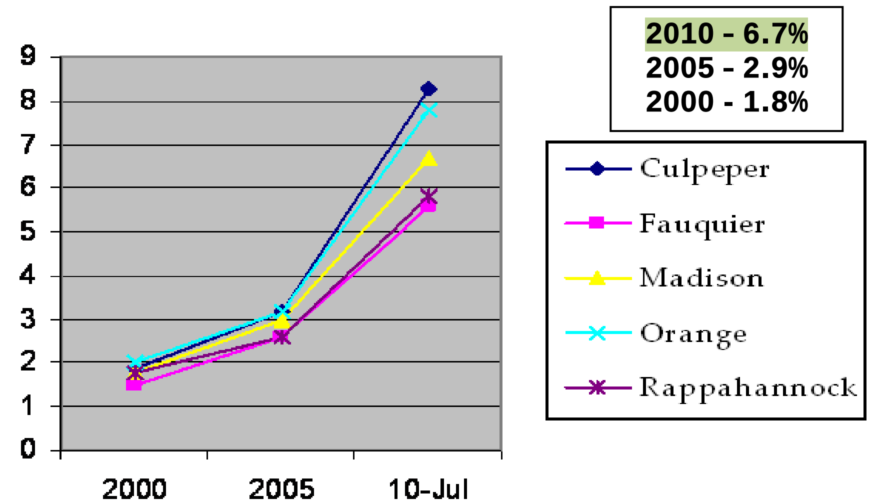


Table 3.11
Unemployment Rate (2002-2009)

	2002	2003	2004	2005	2006	2007	2008	2009
United States	5.8%	6.0%	5.5%	5.1%	4.6%	4.6%	5.8%	9.3%
Virginia	4.2	4.1	3.7	3.5	3.0	3.0	3.9	6.7
Culpeper	3.8	4.0	3.5	3.3	3.2	3.5	4.8	8.1
Fauquier	3.1	3.1	2.7	2.6	2.4	2.5	3.3	5.3
Madison	4.3	3.8	3.0	3.0	2.6	2.6	3.7	6.3
Orange	4.5	4.0	3.3	3.2	3.0	3.2	4.6	7.8
Rappahannock	3.4	3.0	2.6	2.6	2.3	2.5	3.5	5.9

In all jurisdictions in the region, median income increased by more than twenty percent between the years 1999 and 2008. The highest median household incomes can be found in Fauquier County at $81,359, which is significantly higher than the income in any of the other counties in the region.

Table 3.12

Median Household Income (2008)

Locality	1999	2008	Percent change
Culpeper County	$45,290	63,248	39.65%
Fauquier County	$61,999	81,359	31.25%
Madison County	$39,856	51,472	29.14%
Orange County	$42,889	52,158	21.61%
Rappahannock County	$45,943	60,614	31.93%

Source: U.S. Census Bureau American Community Survey 2008

Agriculture-related employment in the region is higher than the national or state average, but currently employs only 2.5 percent of the region's population, significantly less than the 2000 value of 6 percent. The highest percentages of workers are involved in the state and local government sector (20.93 percent), retail trade (14.16 percent), and health care and social assistance (11.3 percent).

DECLARED DISASTERS

Table 3.13
Federally Declared Disasters: Rappahannock-Rapidan Region

1972 - 2010

Locality Affected	Date of Storm	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

Source: FEMA

HAZARD IDENTIFICATION

Requirement §201.6(c) (2) (i): [The risk assessment shall include a description of the type 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.]

Communities throughout the United States are vulnerable to any number of natural hazards that threaten life and property. These include:

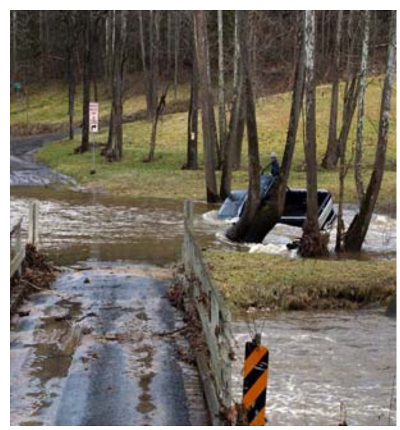
Natural Hazards

- **Flood**
- **Hurricanes and Coastal Storms**
- **Severe Thunderstorms and Tornados**
- **Wildfire**
- **Drought/Extreme Heat**
- **Winter Storms and Freezes**
- **Hail**
- **Erosion**
- **Dam/Levee Failure**
- **Earthquakes**
- **Sinkholes**
- **Landslides**

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.

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. 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.



Floods are usually long-term events that may last for several days. They include river, flash, coastal, and urban floods, 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, 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.

Above: The Rapidan River near Rapidan, Virginia. (Source: Rappahannock-Rapidan Regional Commission)

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

Unadjusted damage amounts in thousands of dollars are as reported, not 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 2007 dollars. The Construction Cost Index was obtained from McGraw Hill Construction Engineering News-Record.

Year	Unadjusted Damages (K)	CCI	Adjustment Factor	Adjusted Damages (Billions)
1985	$500,000	4182	2.05	$1.025
1986	$6,000,000	4295	2.00	$12.000
1987	$1,444,199	4406	1.95	$2.816
1988	$225,298	4519	1.90	$0.428
1989	$1,080,814	4615	1.86	$2.010
1990	$1,636,431	4732	1.81	$2.962
1991	$1,698,781	4835	1.77	$3.007
1992	$762,762	4985	1.72	$1.312

1993	$16,370,010	5210	1.64	$26.847
1994	$1,120,309	5408	1.58	$1.770
1995	$5,110,829	5471	1.57	$8.024
1996	$6,121,884	5620	1.52	$9.305
1997	$8,730,407	5826	1.47	$12.834
1998	$2,496,960	5920	1.45	$3.621
1999	$5,455,263	6059	1.41	$7.692
2000	$1,338,735	6221	1.38	$1.847
2001	$7,309,308	6334	1.35	$9.868
2002	$1,211,339	6538	1.31	$1.587
2003	$2,482,230	6695	1.28	$3.177
2004	$13,970,646	7115	1.20	$16.765
2005	**$42,010,435***	**7446**	**1.15**	**$48.312**
2006	$3,744,636	7751	1.11	$4.157
2007	$2,609,160	7966	1.08	$2.818
2008	**$6,987,392**	8310	1.03	$7.197
2009	$1,000,026	8570	1.00	$1.000

***The devastation and loss of life associated with Hurricanes Katrina and Rita were extensive and, to date, not yet quantified.**

Source: National Oceanic and Atmospheric Administration, Hurricane Research Division

HURRICANES, COASTAL STORMS AND NOR'EASTERS

Hurricanes, tropical storms, nor'easters 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.

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

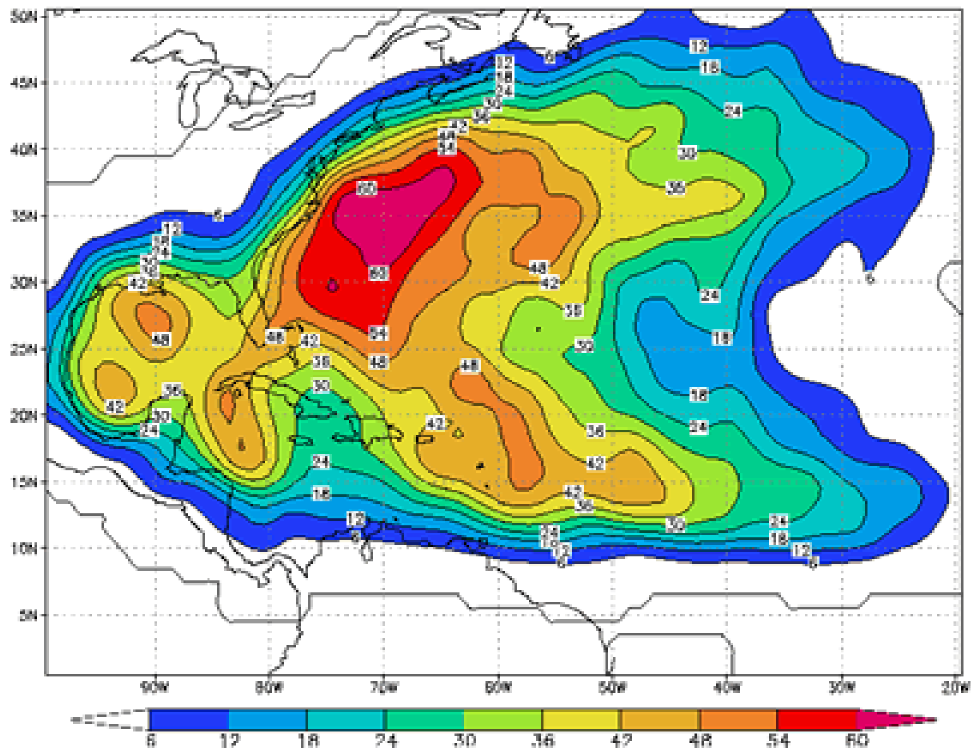
Tropical cyclones, as the name suggests, form over tropical waters and carry with them the heat and moisture typical of those regions. Damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornados. Wind-driven waves, storm surges and tidal flooding are of particular concern in coastal areas where flooding can be more destructive than cyclonic winds.

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 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 (below) integrates data from 1944 to 1999 to indicate the probability of a tropical storm occurring during the June to November Atlantic hurricane season.

Figure 4.1
Probability of a Named Storm

(winds≥39 mph)



Source: National Oceanic and Atmospheric Administration, Hurricane Research Division

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

Figure 4.2
Hurricane Strikes 1950 - 2009

Hurricanes often spawn deadly tornados. In addition, flooding frequently results from the heavy rainfall that typically accompanies these storms.

Occasionally more damaging than hurricanes, nor'easters have a deserved reputation as Virginia's worst winter storms. Nor'easters 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.

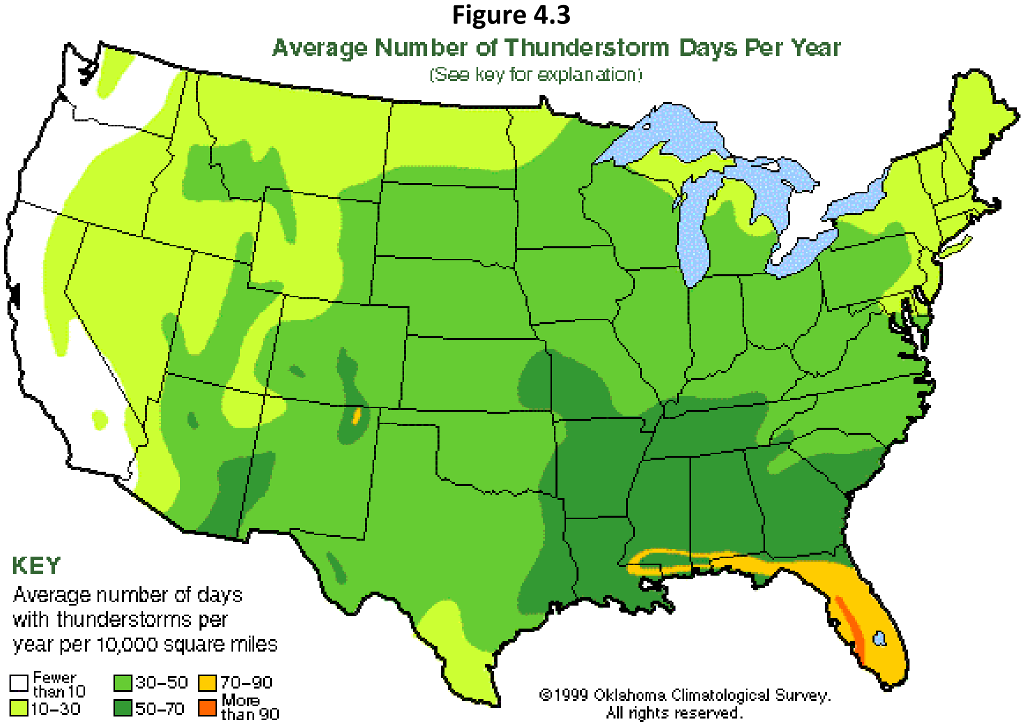
SEVERE THUNDERSTORMS AND TORNADOS

According to the National Weather Service, more than 100,000 thunderstorms occur each year; however, only about 10 percent are classified as severe. 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. 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.

Multiple cloud-to-ground and cloud-to-cloud lightning strokes observed during a nighttime thunderstorm. (Photo courtesy of NOAA Photo Library, NOAA Central Library; OAR/ERL/ National Severe Storms Laboratory)

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.

Figure 4.3



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. On average, 89 people are killed each year by lightning strikes in the United States.

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

VDEM: http://www.vaemergency.com/newsroom/history/stats/lightning/index.cfm

As might be expected, most injuries and deaths associated with lightning strikes occur during those months when thunderstorms are most prevalent, June, July and August.

Table 4.4

Virginia Lightning Statistics by Month							
Month	March	April	May	June	July	August	September
Deaths	0	1	11	14	17	17	3
Injuries	7	3	17	42	91	63	10

VDEM: http://www.vaemergency.com/newsroom/history/stats/lightning/index.cfm

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 Friday September 17, 2004 Tropical Depression Ivan spawned 9 tornados that touched down in Virginia. Around 4:20 P.M. The Meadows neighborhood in Fauquier County, VA (see photo) was hit by a F3 tornado. Twenty-five homes were damaged; however, there were no injuries. Losses county-wide were estimated at more than $1.4 million.

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.

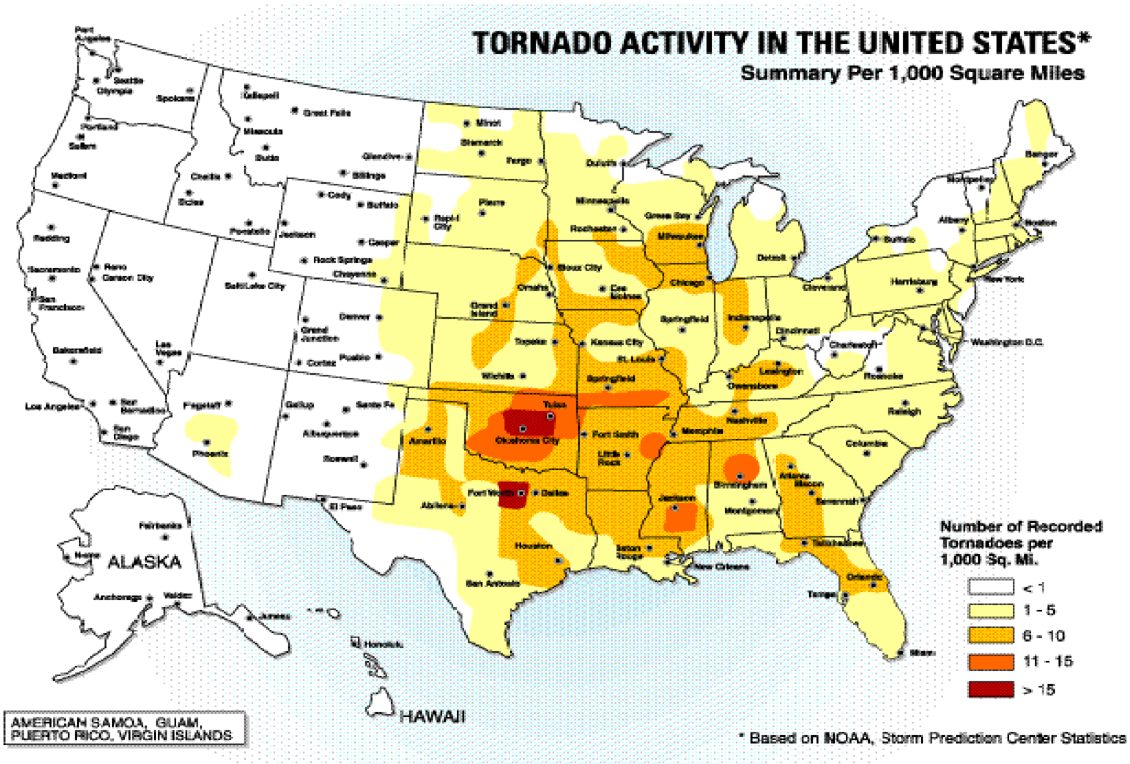
Photo: Vincent Vala, Culpeper Star-Exponent

Table 4.5

Fujita Scale of Tornado Winds and Damage (statistics 1950-2007)								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.	183	34	0 / 0	8.2	**EF0**	Weak	65-85
F1	Moderate	73-112	Moderate. Roofs off; trees snapped; trailers moved or overturned.	253	47	1 / 97	65.5	**EF1**	Moderate	86-110
F2	Strong	113-157	Considerable. Weak structures and trailers demolished; cars blown off road.	80	15	3 / 94	148.2	**EF2**	Strong	111-135
F3	Severe	158-206	Roofs & some walls torn off well constructed buildings; some rural buildings demolished; cars lifted and tumbled.	24	4	19 / 104	140.5	**EF3**	Severe	136-165
F4	Devastating	207-260	Houses leveled leaving piles of debris; cars thrown some distance.	2	0.1	4 / 248	50	**EF4**	Devastating	166-200

Source: http://www.vaemergency.com/newsroom/history/tornado.cfm

Figure 4.4



Source: American Society of Civil Engineers

In Virginia, tornados occur most frequently in July. The hot, humid conditions typical of this month often generate late afternoon or evening thunderstorms which may result in tornadic activity. Despite their frequency, July tornados tend to be weak, with 91% falling into the F0 or F1 category (see chart). While not as many tornados occur in the Spring and Fall, storms occurring during those seasons tend to be stronger with a greater potential to be deadly.

Table 4.6

Virginia Tornados by Month: 1950-2007												
Intensity	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
F/EF0-F/EF1	10	13	16	37	58	47	80	65	73	20	14	2
F/EF2-F/EF4	3	0	3	13	13	12	8	13	25	11	5	0
Total	13	13	19	49	71	59	88	78	97	31	19	2
% weak	77	100	84	73	82	80	91	83	74	65	74	100
% Strong	23	0	16	27	18	20	9	17	26	35	26	0

Source: http://www.vaemergency.com/newsroom/history/tornado.cfm

Figure 4.5 (below) summarizes the frequency and strength of extreme windstorms across the United States. Produced by the Federal Emergency Management Agency, the map represents 40 years of tornado history and over 100 years of hurricane history.

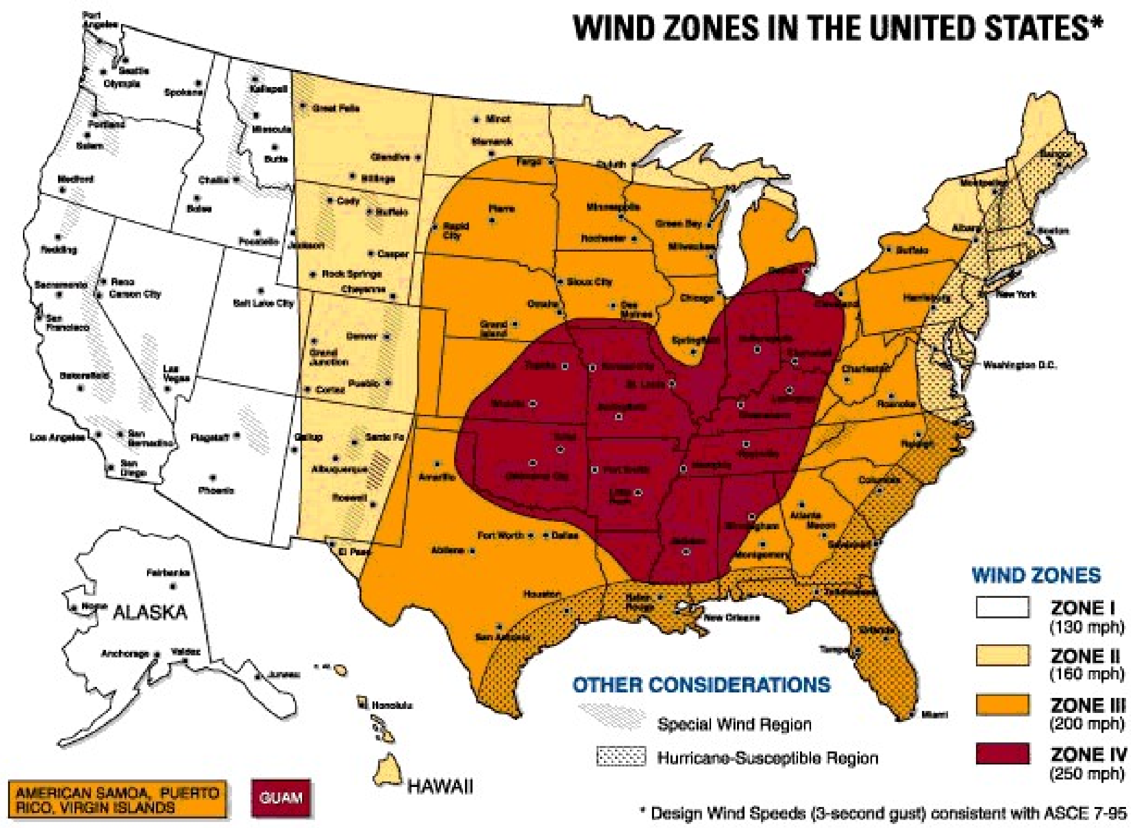
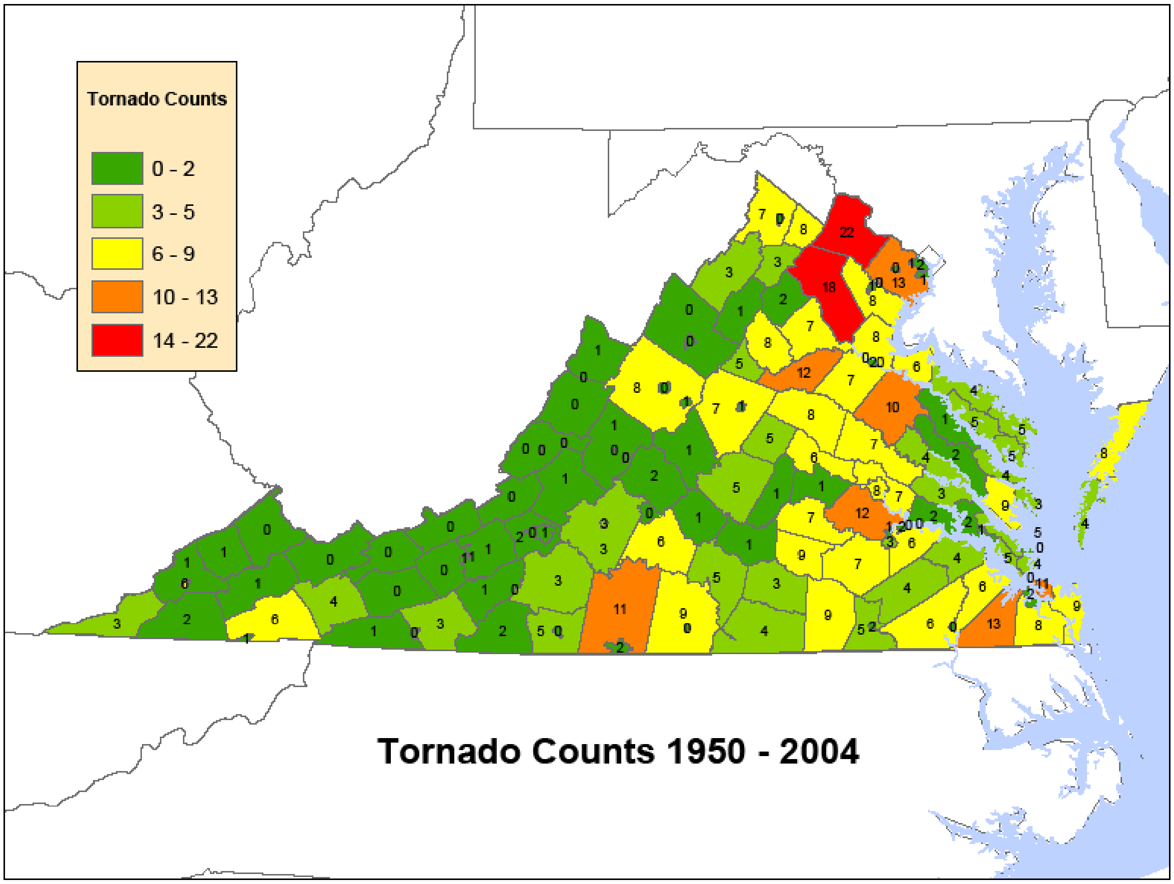


Figure I.2 Wind zones in the United States

Source: Federal Emergency Management Agency

Figure 4.6

Virginia Tornado Counts 1950-2004



Source:
http://www.vaemergency.com/newsroom/history/stats/tornado/tornado_counts2004.pdf

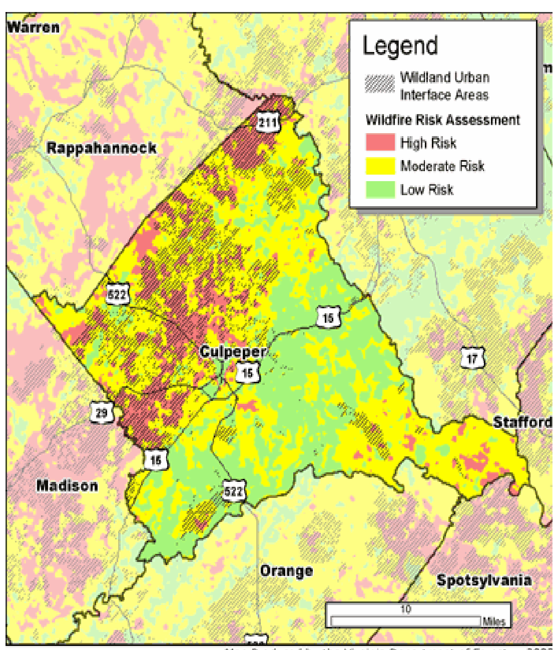
WILDFIRE

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. Records indicate that most of Virginia's wildfires are caused by people. 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. Three percent of forest fires in Virginia are the result of lightning strikes; ninety-seven percent are caused by humans.

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.

FIGURE 4.7
Culpeper County
Wild-land/Urban Interface & Wildfire Risk Assessment



Map Produced by the Virginia Department of Forestry, 2003

DROUGHT / EXTREME HEAT

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, and
- Socio-economic.

Drought 2002 – Rapidan River intake pump for Town Of Orange: Photo: The Orange County Review.

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 4.8

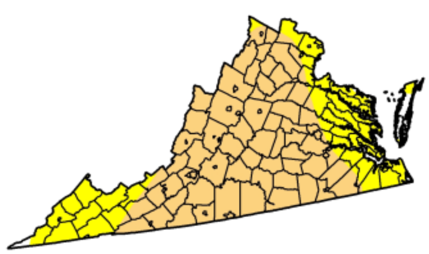
U.S. Drought Monitor

Virginia

March 1, 2011
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	1.78	98.22	69.44	0.00	0.00	0.00
Last Week (02/22/2011 map)	1.78	98.22	69.44	0.00	0.00	0.00
3 Months Ago (11/30/2010 map)	50.71	49.30	3.36	0.00	0.00	0.00
Start of Calendar Year (12/28/2010 map)	81.67	18.33	0.00	0.00	0.00	0.00
Start of Water Year (09/28/2010 map)	13.71	86.29	49.67	28.15	0.79	0.00
One Year Ago (02/23/2010 map)	100.00	0.00	0.00	0.00	0.00	0.00



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

Released Thursday, March 3, 2011
L. Edwards, Western Regional Climate Center

TABLE 4.7
Drought Severity Classification

Category	Description	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.

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

Table 4.8

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 4.9

Annual U.S. Extreme Heat Summary

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Fatalities	158	166	167	36	6	158	253	105	71	45
Injuries	469	445	378	174	74	298	1,513	1,886	217	204

Source: http://www.economics.noaa.gov/?goal=weather&file=events/temp

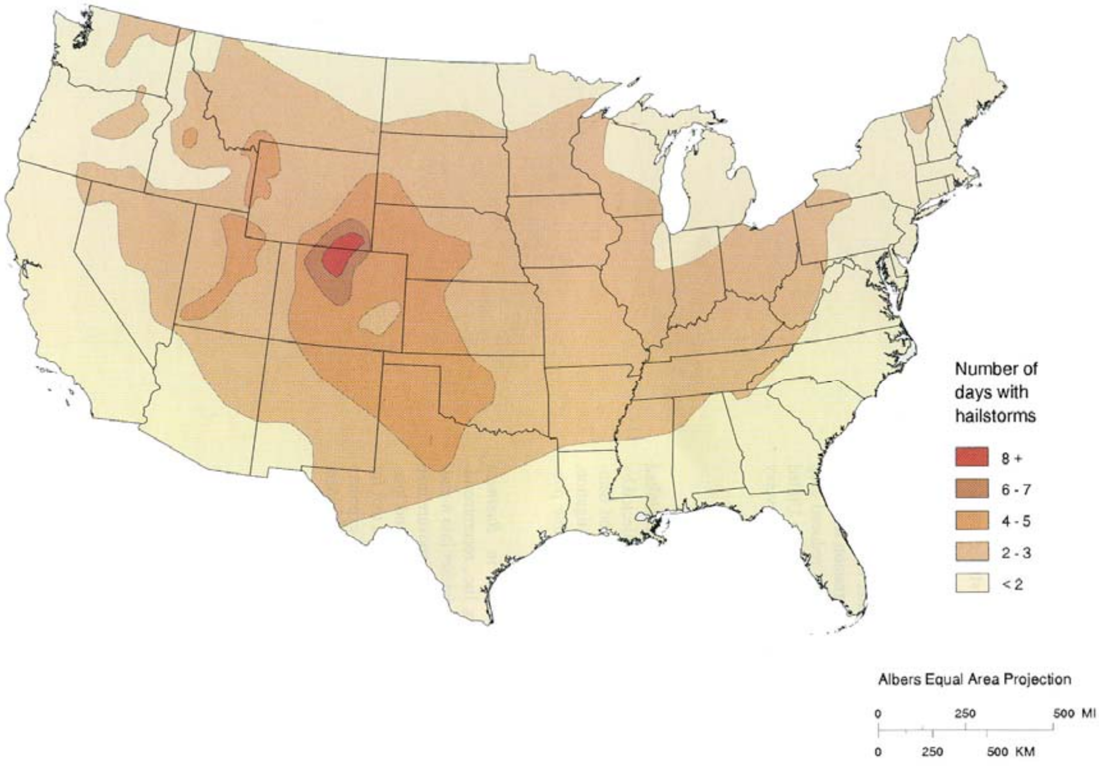
HAIL

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.

Large hail collects on streets and grass during a severe thunderstorm. Larger stones appear to be nearly two to three inches in diameter. (NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory)

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

Figure 4.9
Annual Frequency of Hailstorms in the United States



WINTER STORMS AND FREEZES

Back-to-back snowstorms of historic proportions plagued the Rappahannock-Rapidan region in winter, 2010. Photo by Vincent Vala, Culpeper Star-Exponent.

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.

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 prone areas are 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 and the implementation of erosion and sediment control regulations are recognized as fundamental to managing erosion.

DAM FAILURE

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.

Currently, there are about 80,000 dams in the United States. Most 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. Failure of even small structures can result in loss of life and significant property damage. The Virginia Department of Conservation and Recreation's Division of Dam Safety has recently (Dec. 2010) updated its safety regulations and is in the process of evaluating the many dams constructed with or without proper permits throughout the Commonwealth. Of particular concern are the many aging impoundments that have not been properly maintained and lie upstream of developed properties.

EARTHQUAKES

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. (Source: Rappahannock-Rapidan Regional Commission)

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.

Earth's areas of greatest instability occur along the perimeters of its tectonic plates. The North American plate is bounded on the east by the mid-Atlantic ridge, located, as the name suggests, in the middle of the Atlantic Ocean between North America and Europe. The western edge of the North American plate abuts the eastern edge of the Pacific plate and marks the west coast of North America. As might be expected, the Pacific coastal area of the United States is far more likely to experience earthquakes than the eastern coastal region of the United States. It should be noted, however, that 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.

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 (see **Table 4.10**). 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 4.11**.

Table 4.10
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.

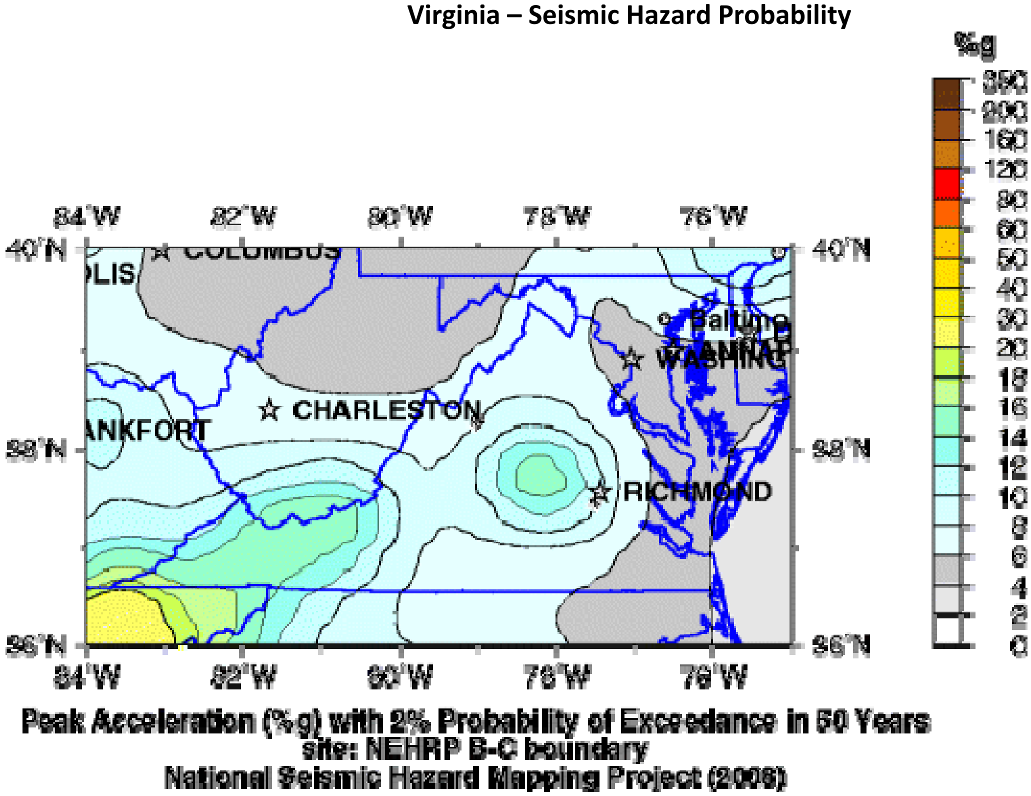
Table 4.11
Modified Mercalli Intensity Scale for Earthquakes

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

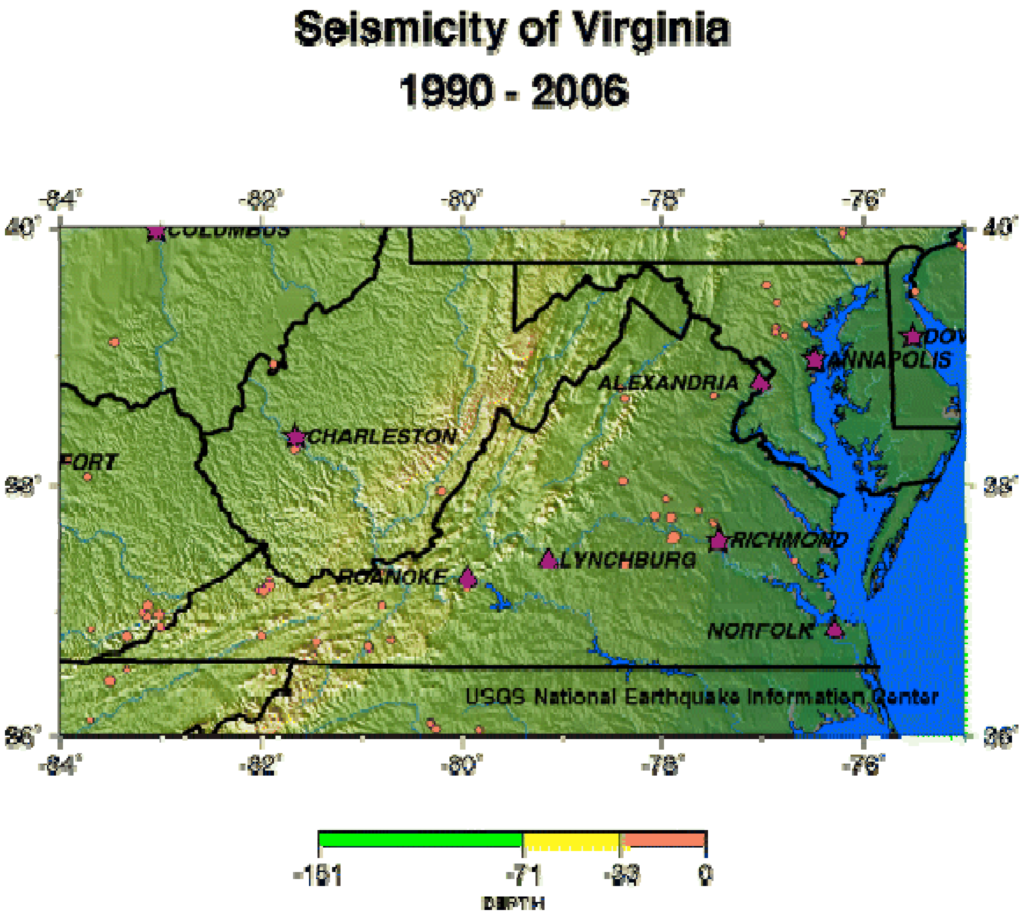
The probability that ground motion will reach a certain level during an earthquake is indicated below (Figure 4.10). The data show peak horizontal ground acceleration (the fastest measured change in speed, for a particle at ground level that is moving horizontally due to an earthquake) with a 10 percent probability of exceedance in 50 years.

Figure 4.10
Virginia – Seismic Hazard Probability



Source: United States Geological Survey

Figure 4.11



Depth is in kilometers.
Purple Triangles: Cities
Purple Star: Capital City
Circles: Earthquakes (color represents depth range)

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. As 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.

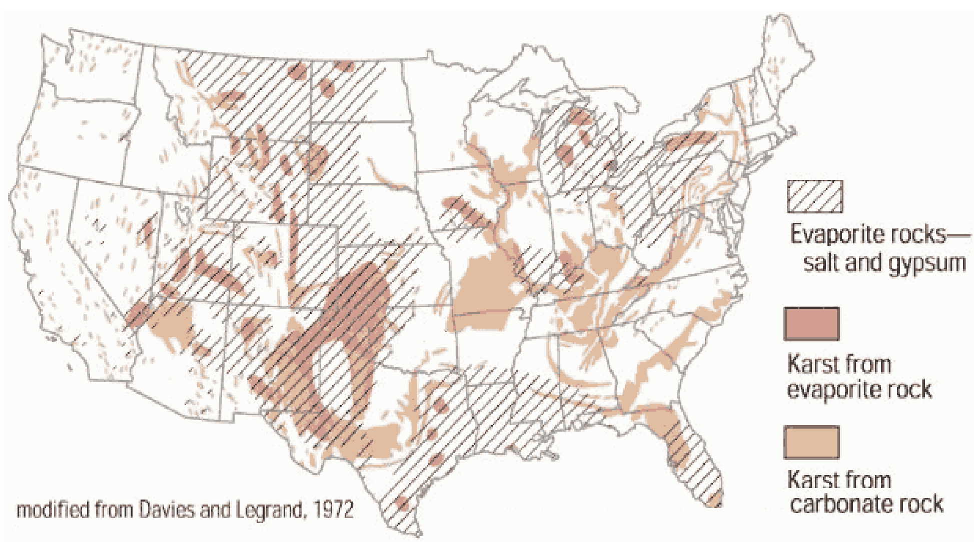
Although a sinkhole can form without warning, specific signs can signal potential development:

- 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 the Federal Emergency Management Agency (FEMA), insurance claims for damage resulting from sinkhole formation have increased 1,200 percent from 1987 to 1991, costing nearly $100 million.

Driver Trapped in Sinkhole Near Lynchburg,VA
(Leonard Harville / January 25, 2010)

Figure 4.12

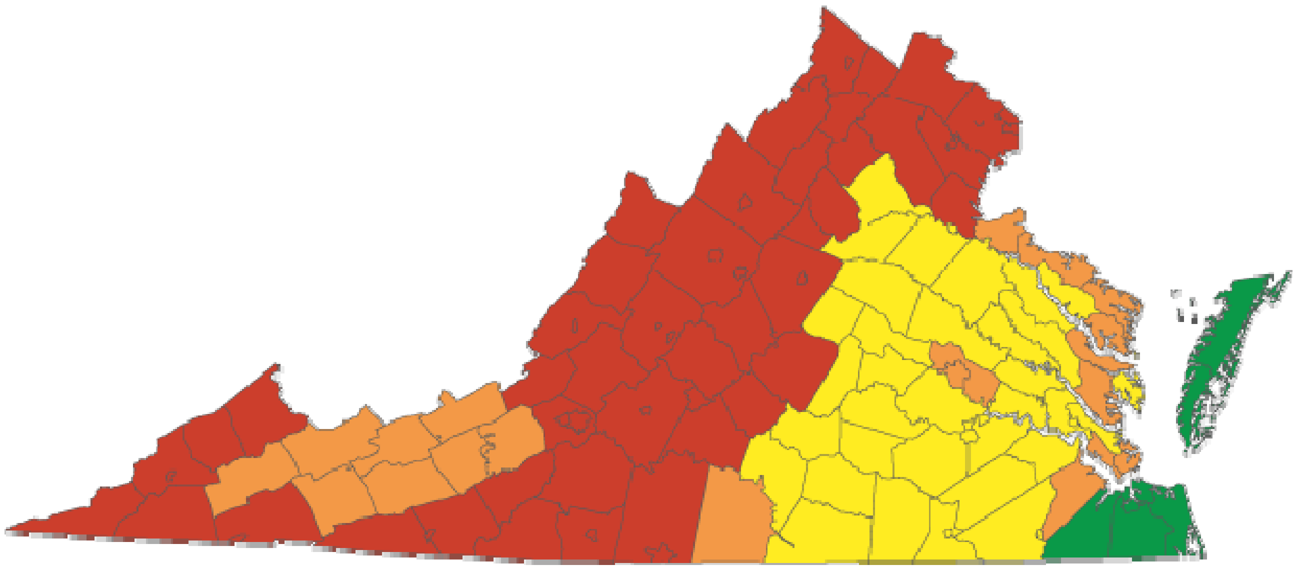


LANDSLIDES

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.

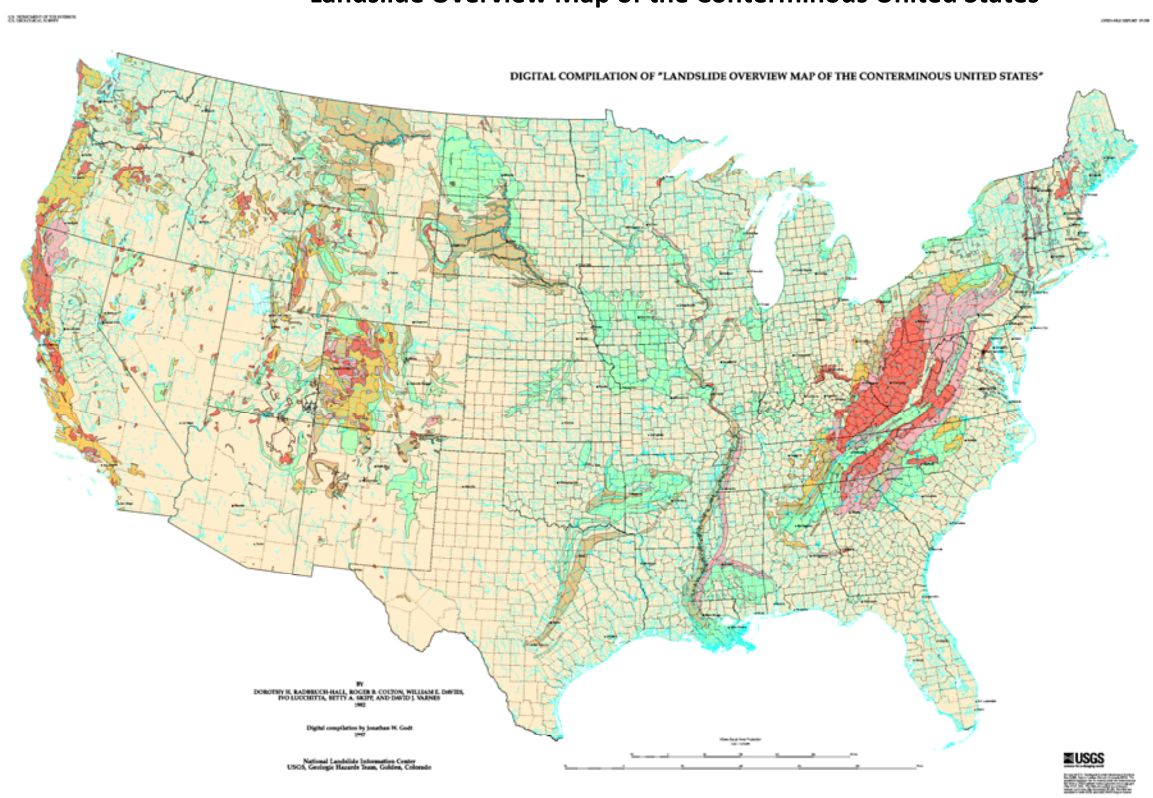
Expansion of urban and recreational development into hillside areas results in increased threat of landslides each year. Landslides may wrecking buildings, rupture gas, water, and sewer mains, disrupt power and communication lines and block transportation routes. Soil creep, slope slump, rock slides 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. Photo from The debris Flows of Madison County, Virginia: 34th Annual Virginia Geological Field Conference Guidebook.



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

Figure 4.13
Landslide Overview Map of the Conterminous United States



EXPLANATION

LANDSLIDE INCIDENCE

- Low (less than 1.5% of area involved)
- Moderate (1.5%-15% of area involved)
- High (greater than 15% of area involved)

LANDSLIDE SUSCEPTIBILITY/INCIDENCE

- Moderate susceptibility/low incidence
- High susceptibility/low incidence
- High susceptibility/moderate incidence

Susceptibility not indicated where same or lower than incidence. Susceptibility to landsliding was defined as the probable degree of response of [the areal] rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landsliding. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated.

Source: United States Geological Surveyhttp://pubs.usgs.gov/pp/p1183/plate1.html

DATA SOURCES

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

HAZARD ANALYSIS

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**
- **Erosion**
- **Earthquakes**
- **Sinkholes**
- **Landslides**
- **Dam/Levee 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.[1]

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 11/30/2010. Because of the large number of events, details of only a few have been included.[2] Historical evidence clearly illustrates the likelihood of flooding in the region. Floods referenced below resulted in a total of 22 deaths, no reported injuries, approximately $95.179M in reported property damages and approximately $40.215M in crop damage claims.

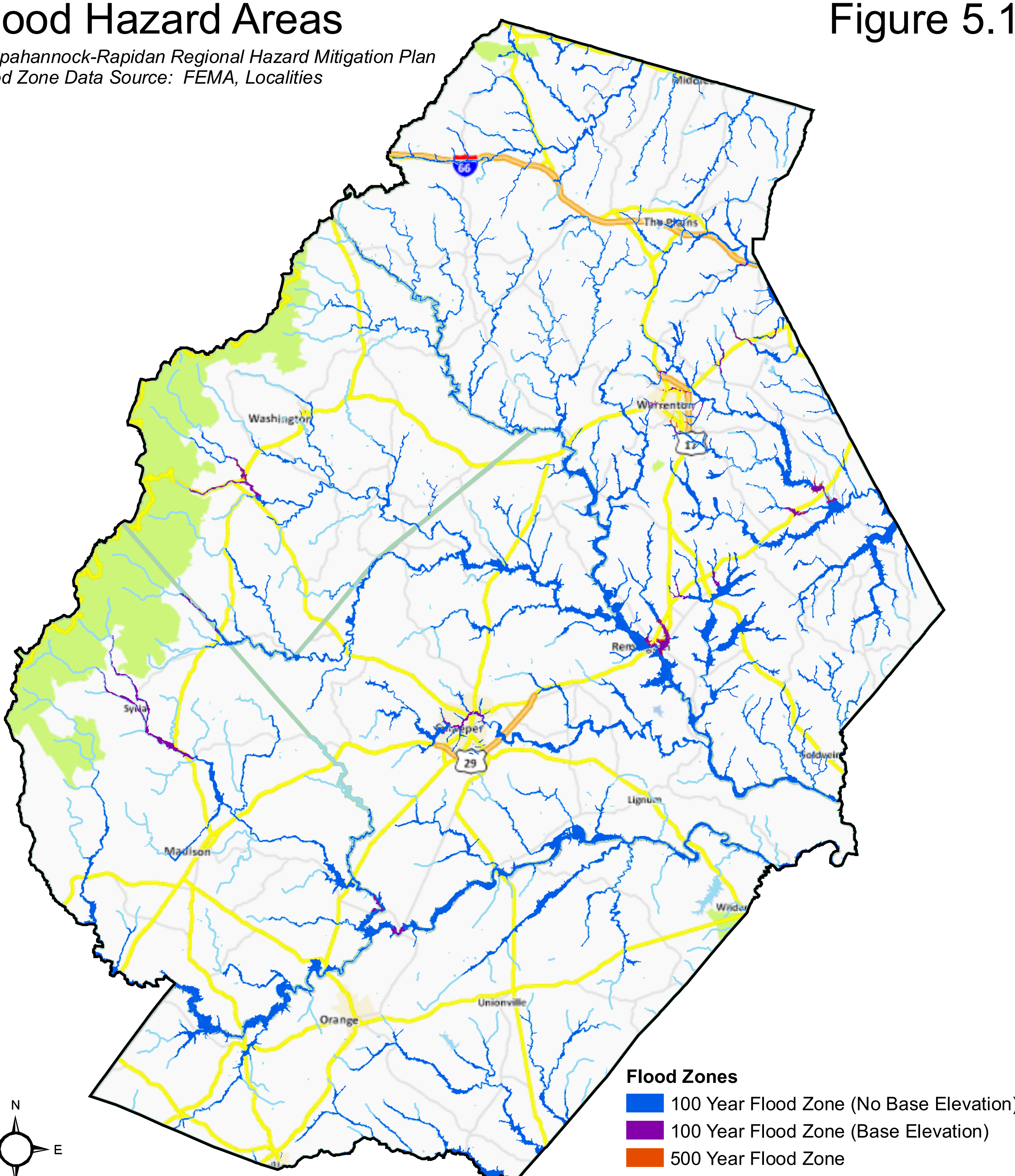
[1] The *Community Profile* section (Section 3 of this Plan) provides additional detail with regard to the region's geographic position within Virginia and other general geographic characteristics.

[2] 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.

Flood Hazard Areas

Figure 5.1

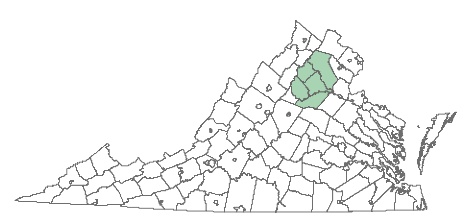
Rappahannock-Rapidan Regional Hazard Mitigation Plan
Flood Zone Data Source: FEMA, Localities



Rappahannock-Rapidan
REGIONAL COMMISSION

Miles
0 5 10 15 20

Map created for Rappahannock-Rapidan Regional Hazard Mitigation Plan Update and is intended for general planning purposes only. Data is from various sources and may vary in accuracy and completeness.
Date: 5/10/2011 File: Flood_Zones_Region.mxd



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.

Table 5.1
Flood Events: Rappahannock-Rapidan Region
(01/01/1995 – 11/30/2010)

Location	Number of Flood Events	Deaths	Injuries	Property Damage*	Crop Damage*
Culpeper County	40	4	0	$20.4 M	$644K
Fauquier County	46	4	0	$20.3M	$136K
Madison County	39	5	0	$19.8M	$36.831M
Orange County	32	4	0	$18.474M	$2.131M
Rappahannock County	29	5	0	$16.209M	$474K
REGIONAL TOTALS:	186**	22	0	$95.179M	$40.215M

Source: National Climatic Data Center
* Approximate numbers based on NCDC records.
** Many of the same events impacted more than one county

Significant Events[3]:

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.

[3] Details from events slightly modified from National Climatic Data Center's storm database.

Flood Hazard Areas: Culpeper County

Figure 5.2

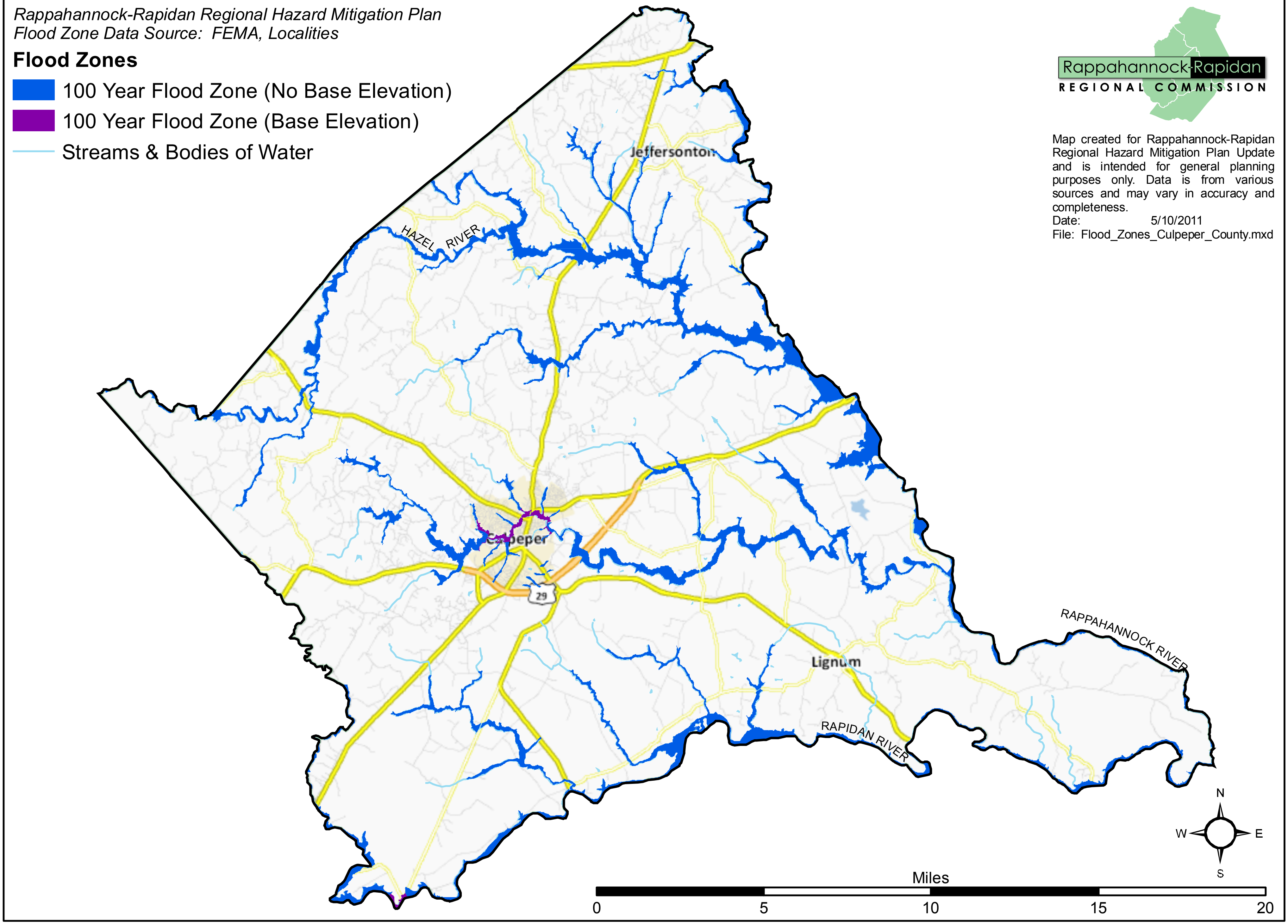


Figure 5.3

Flood Hazard Areas: Town of Culpeper

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Flood Zone Data Source: FEMA, Localities

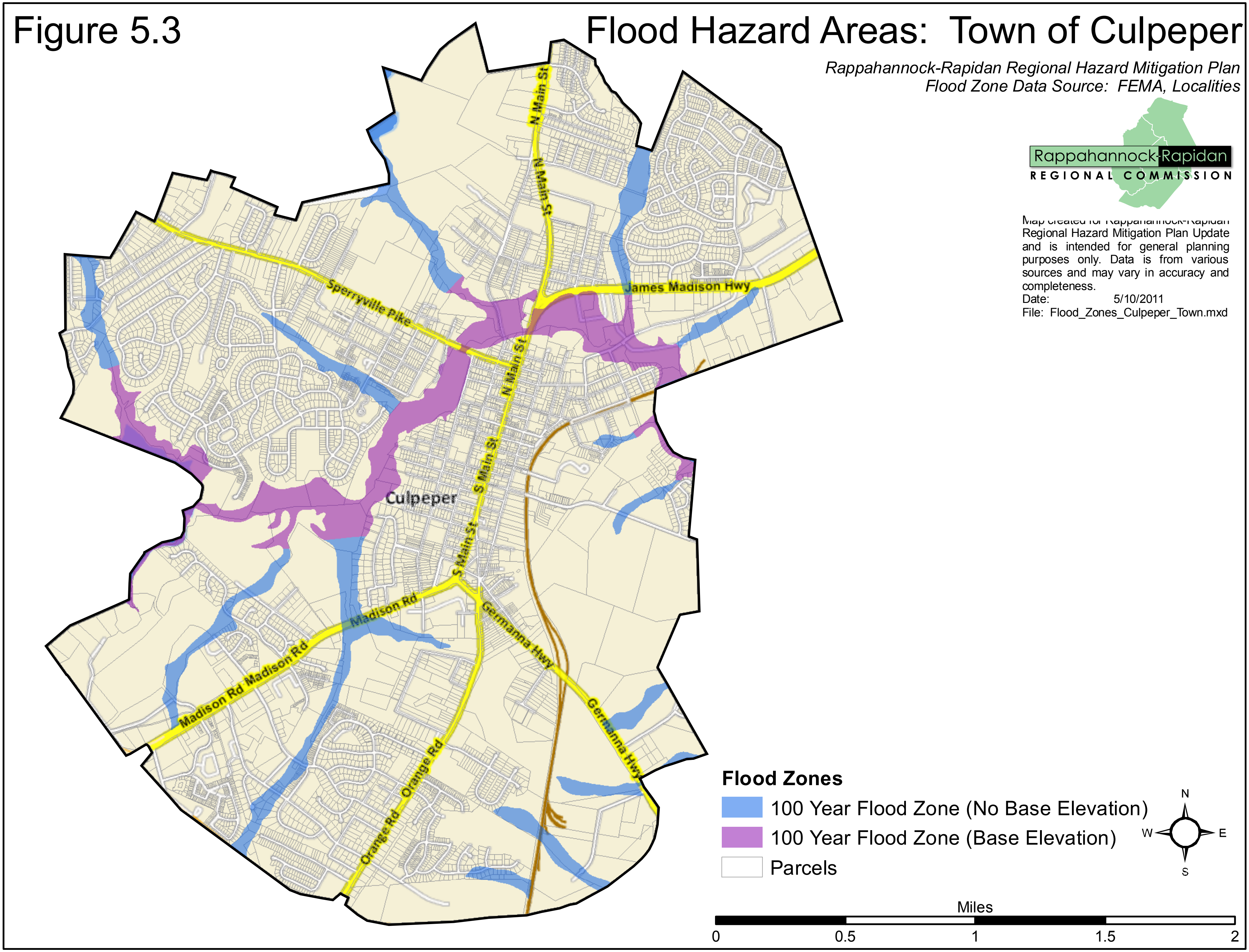
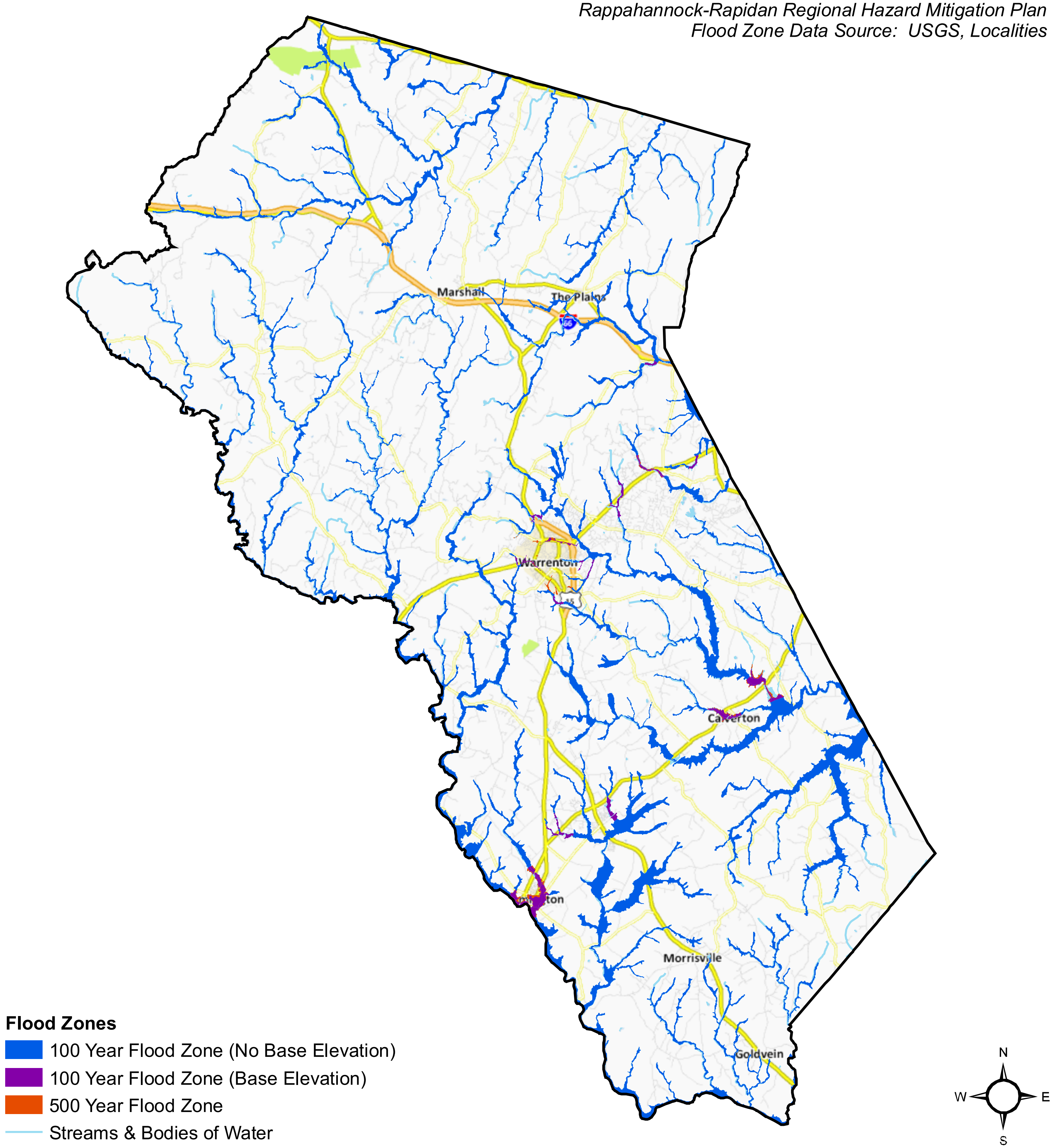


Figure 5.4 Flood Hazard Areas: Fauquier County

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Flood Zone Data Source: USGS, Localities



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Miles
0 2.5 5 7.5 10

Map created for Rappahannock-Rapidan Regional Hazard Mitigation Plan Update and is intended for general planning purposes only. Data is from various sources and may vary in accuracy and completeness.
Date: 5/10/2011 File: Flood_Zones_Fauquier.mxd

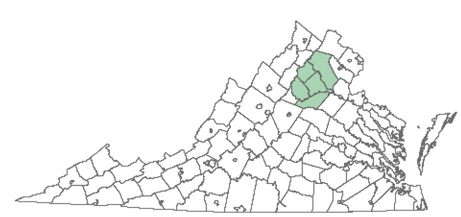
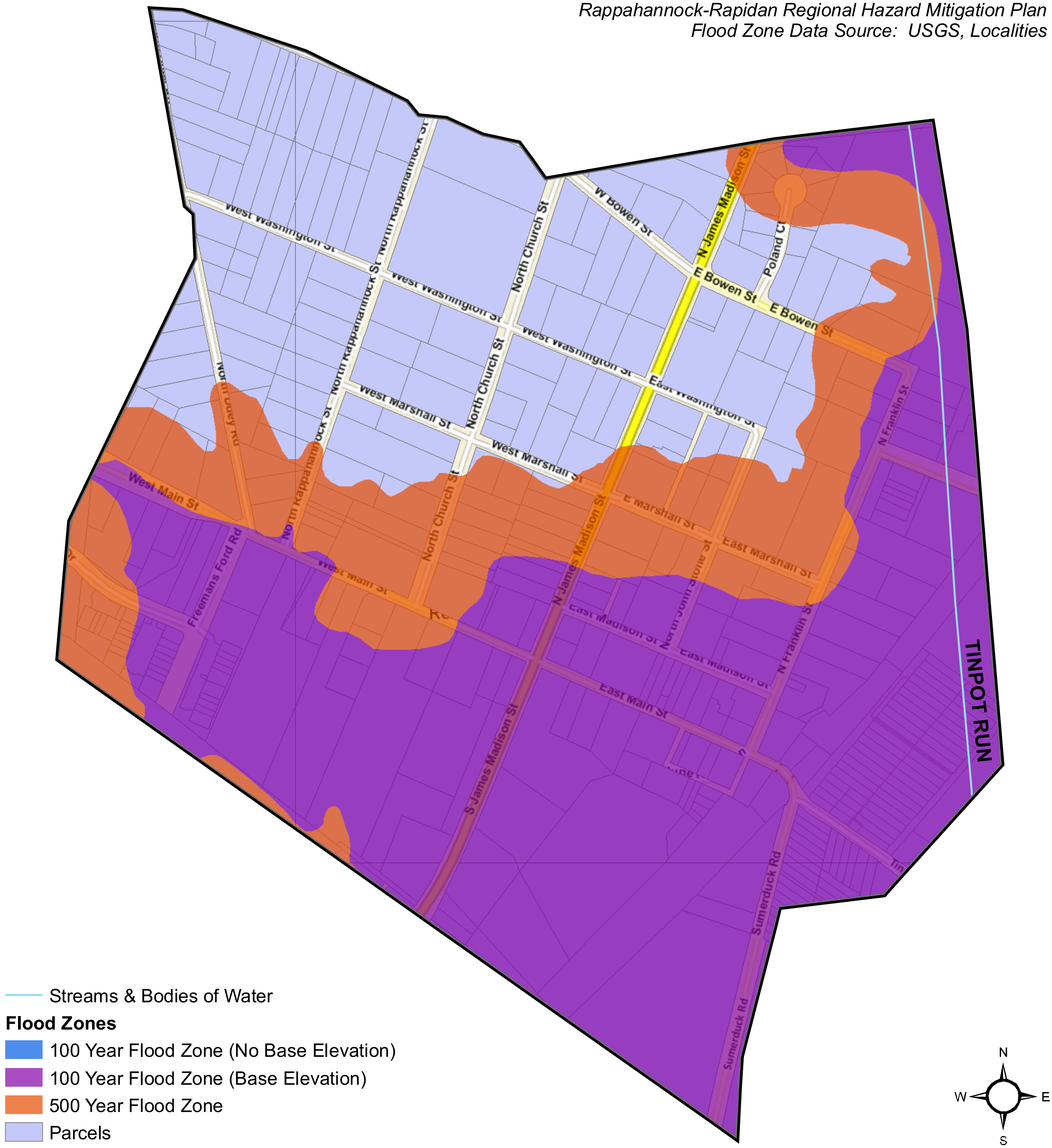


Figure 5.5 Flood Hazard Areas: Town of Remington

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Flood Zone Data Source: USGS, Localities



Rappahannock-Rapidan
REGIONAL COMMISSION

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Date: 5/10/2011 File: Flood_Zones_Remington.mxd

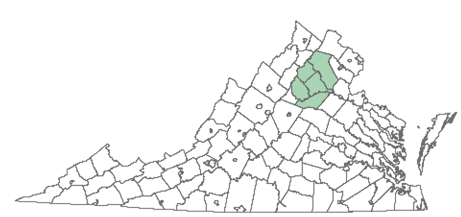
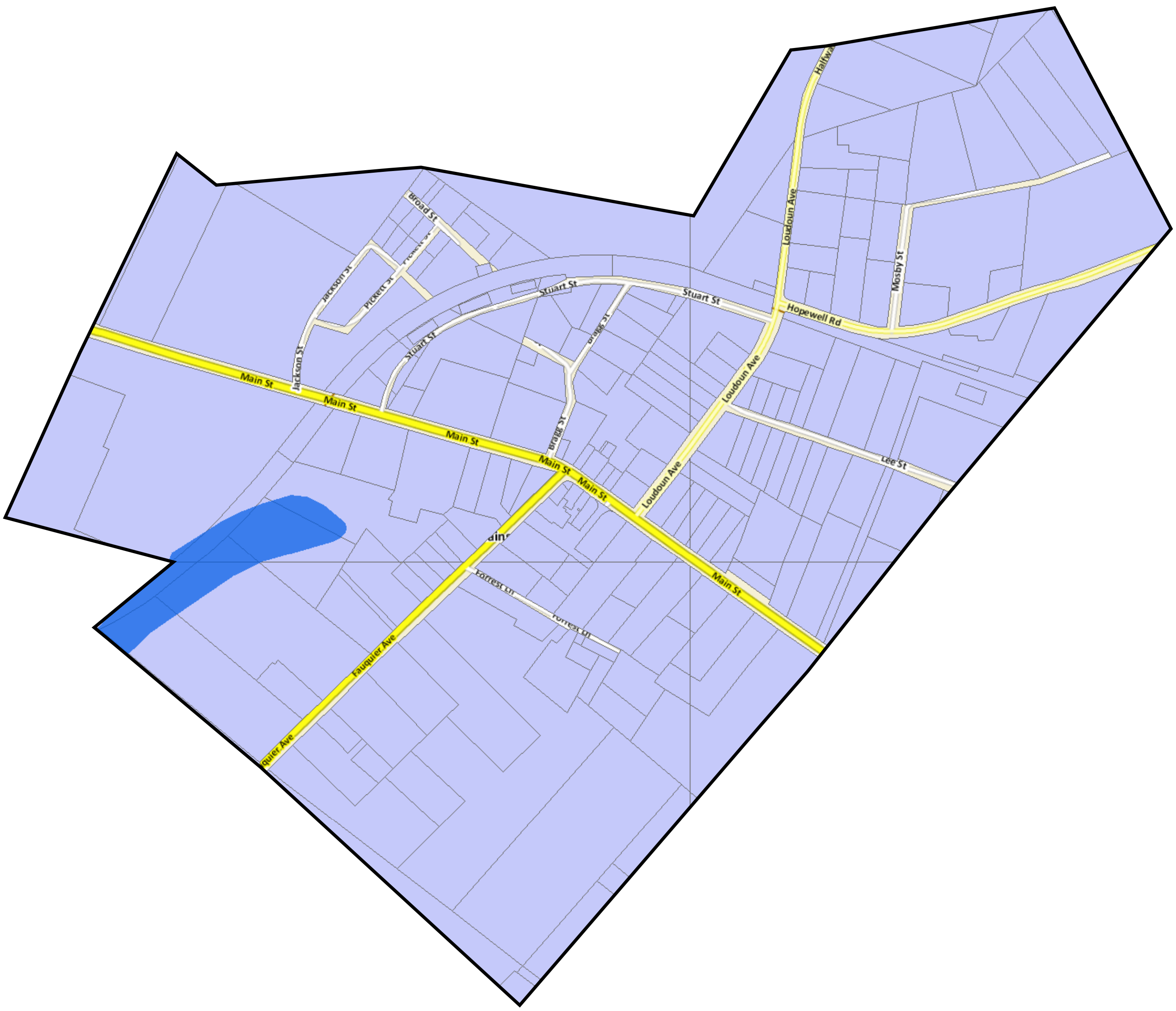


Figure 5.6 Flood Hazard Areas: Town of The Plains

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Flood Zone Data Source: USGS, Localities



Streams & Bodies of Water
100 Year Flood Zone (No Base Elevation)
Parcels

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Rappahannock-Rapidan
REGIONAL COMMISSION

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Map created for Rappahannock-Rapidan Regional Hazard Mitigation Plan Update and is intended for general planning purposes only. Data is from various sources and may vary in accuracy and completeness.
Date: 6/1/2011 File: Flood_Zones_ThePlains.mxd

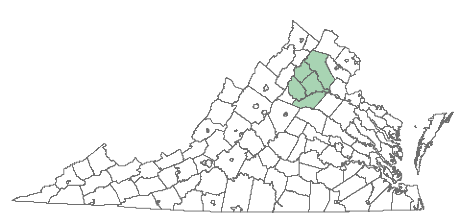
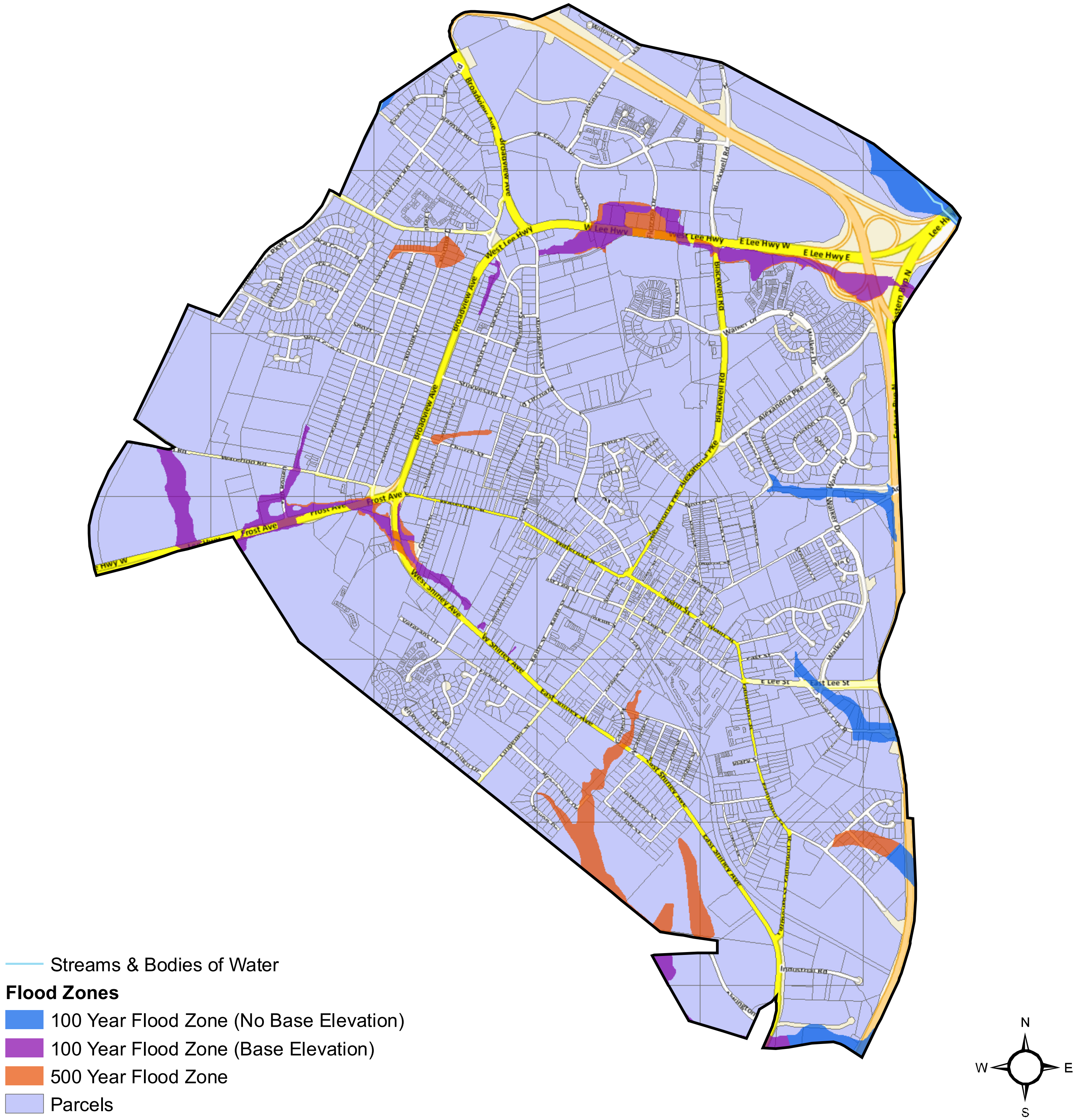


Figure 5.7 Flood Hazard Areas: Town of Warrenton

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Flood Zone Data Source: USGS, Localities



Rappahannock-Rapidan
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Miles
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Date: 6/1/2011 File: Flood_Zones_Warrenton.mxd

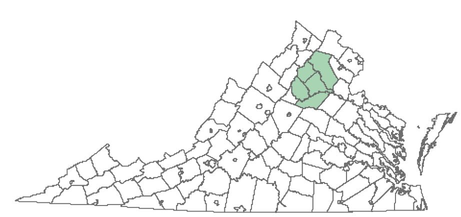
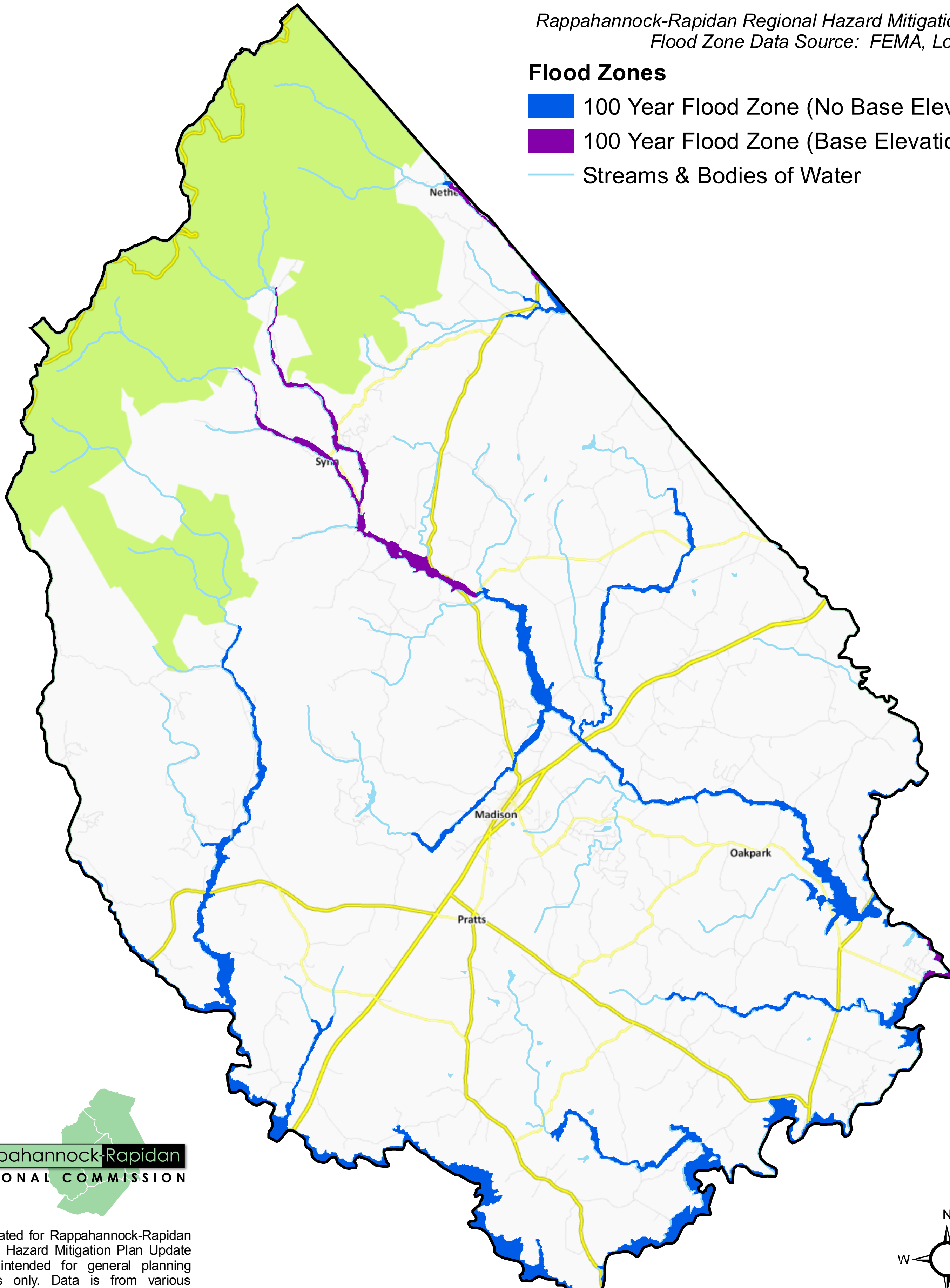


Figure 5.8 Flood Hazard Areas: Madison County

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Flood Zone Data Source: FEMA, Localities

Flood Zones

- 100 Year Flood Zone (No Base Elevation)
- 100 Year Flood Zone (Base Elevation)
- Streams & Bodies of Water



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Rappahannock-Rapidan
REGIONAL COMMISSION

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Date: 5/16/2011
File: Flood_Zones_Madison_County.mxd

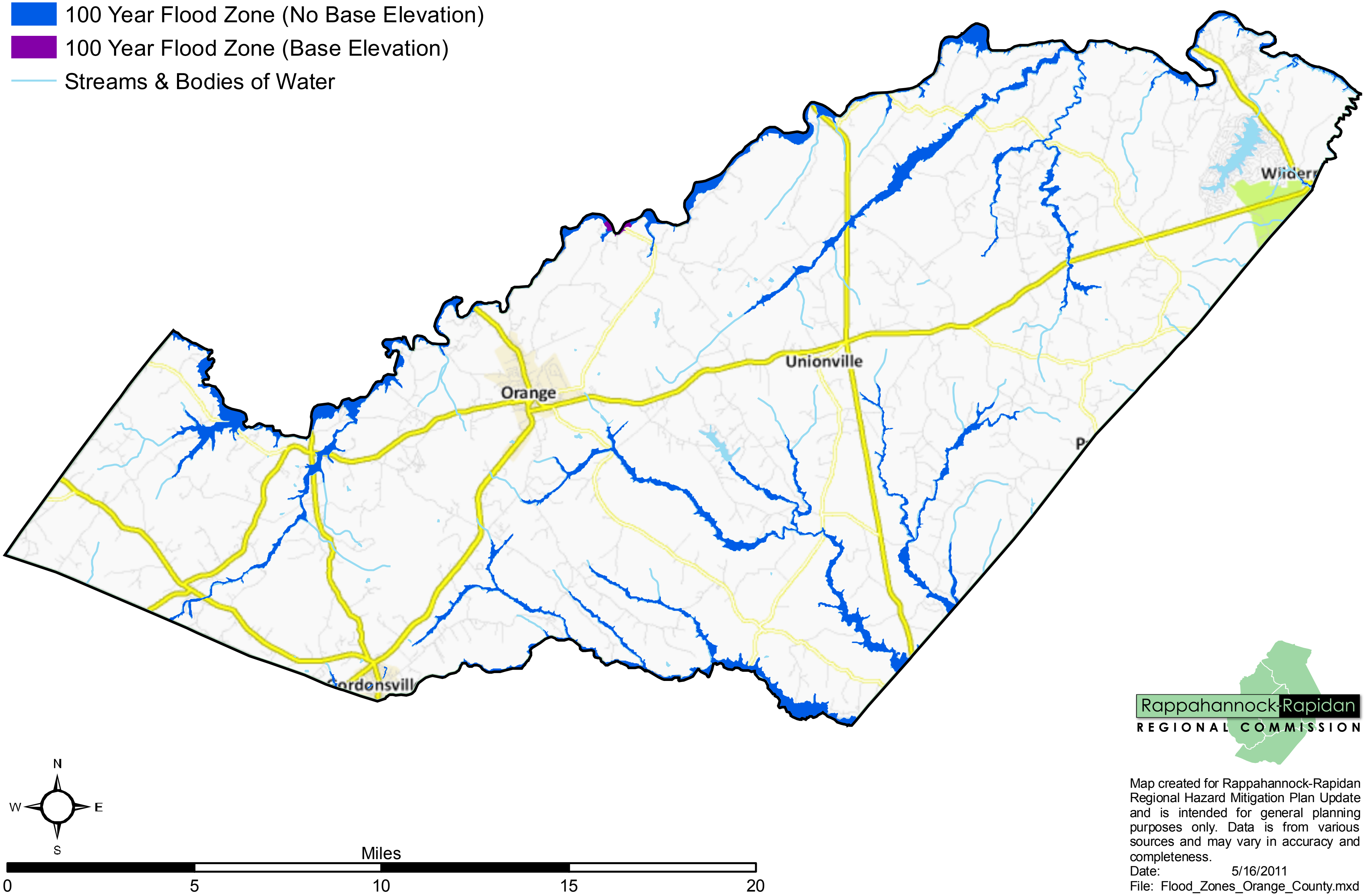
Flood Hazard Areas: Orange County

Figure 5.9

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Flood Zone Data Source: FEMA, Localities

Flood Zones

- 100 Year Flood Zone (No Base Elevation)
- 100 Year Flood Zone (Base Elevation)
- Streams & Bodies of Water



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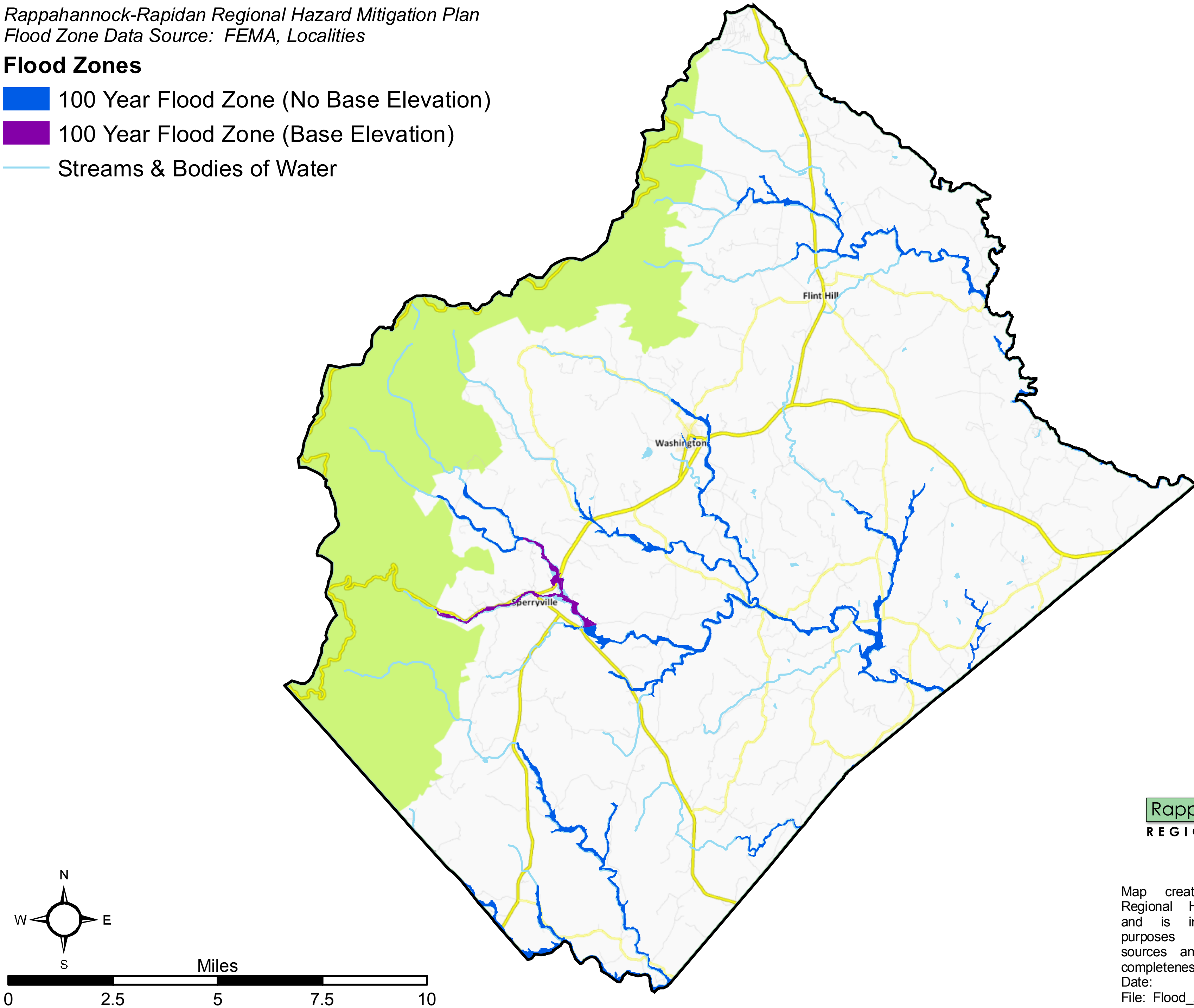
Date: 5/16/2011

File: Flood_Zones_Orange_County.mxd

Flood Hazard Areas: Rappahannock County

Figure 5.10

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Flood Zone Data Source: FEMA, Localities



Rappahannock-Rapidan REGIONAL COMMISSION

Map created for Rappahannock-Rapidan Regional Hazard Mitigation Plan Update and is intended for general planning purposes only. Data is from various sources and may vary in accuracy and completeness.

Date: 5/16/2011

File: Flood_Zones_Rappahannock_County.mxd

Flood Hazard Areas: Town of Washington

Figure 5.11

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Flood Zone Data Source: FEMA, Localities

Rappahannock-Rapidan
REGIONAL COMMISSION

Flood Zones

- 100 Year Flood Zone (No Base Elevation)
- 100 Year Flood Zone (Base Elevation)
- Streams & Bodies of Water
- Parcels

Map created for Rappahannock-Rapidan Regional Hazard Mitigation Plan Update and is intended for general planning purposes only. Data is from various sources and may vary in accuracy and completeness.
Date: 5/16/2011
File: Flood_Zones_Washington_Town.mxd

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.

HURRICANES, TROPICAL STORMS AND NOR'EASTERS

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).

Table 5.2
Significant Tropical Cyclones: Rappahannock-Rapidan Region
(1851 – 2010)

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

Source: National Hurricane Center
Note: Category indicates strength of storm in Rappahannock-Rapidan region, rather than highest strength of storm.

NOR'EASTERS

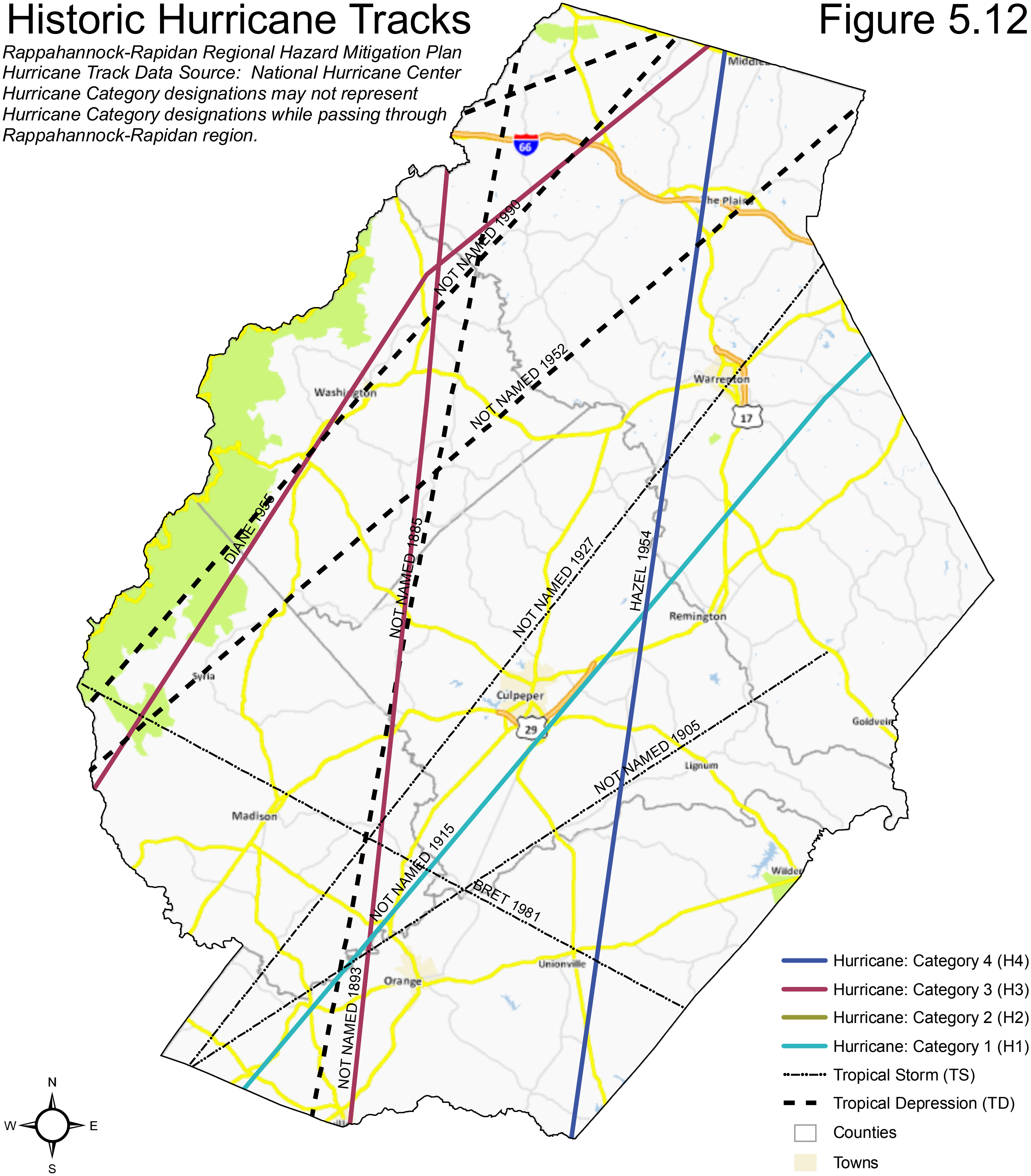
The most powerful storms to impact the Rappahannock-Rapidan region in winter are nor'easters. Unlike hurricanes, which usually move through the region in a 24-hour period, nor'easters may linger for several days delivering singly, or in combination, high winds, driving rain, heavy snow, sleet and ice. 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

Historic Hurricane Tracks

Figure 5.12

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Hurricane Track Data Source: National Hurricane Center
Hurricane Category designations may not represent
Hurricane Category designations while passing through
Rappahannock-Rapidan region.

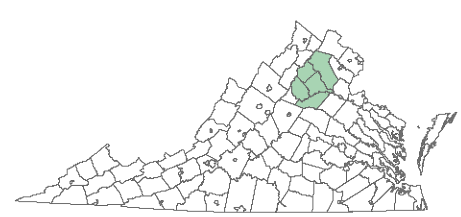


Rappahannock-Rapidan
REGIONAL COMMISSION

Miles

0 5 10 15 20

Map created for Rappahannock-Rapidan Regional Hazard Mitigation Plan Update and is intended for general planning purposes only. Data is from various sources and may vary in accuracy and completeness.
Date: 5/10/2011 File: Historic_Hurricane_Tracks.mxd



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.

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.

Figure 5.13 - Regional Total Accumulations: Blizzard One

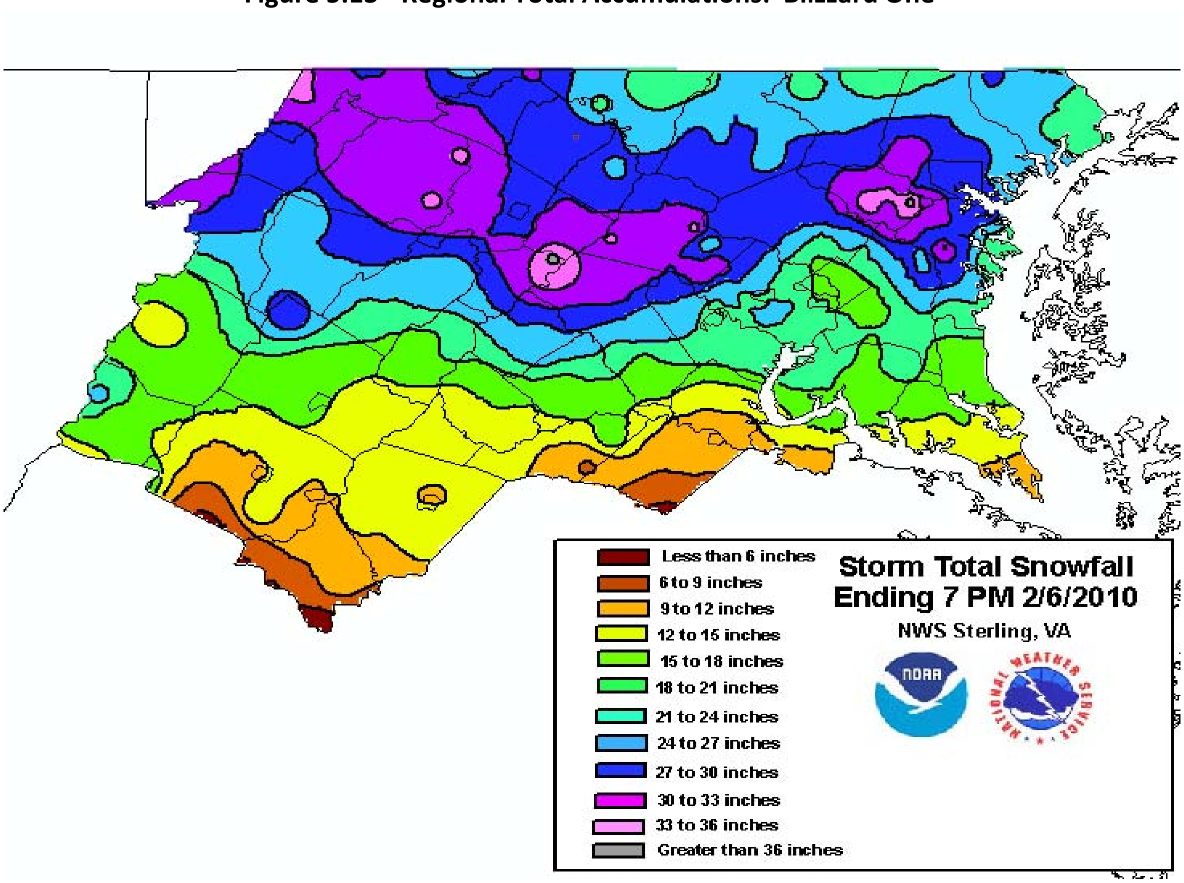


Table 5.3
Significant Winter Storm Events: Rappahannock-Rapidan Region
01/01/1995 – 11/30/2010

Location	Number of Events	Deaths	Injuries	Property Damage*	Crop Damage*
Culpeper County	61	3	52	$9.85 M	$0
Fauquier County	81	4	52	$9.75M	$1.2M
Madison County	71	3	52	$10.73M	$1.275M
Orange County	64	1	1	$9.554M	$0
Rappahannock County	81	2	51	$10.025M	$1.275
REGIONAL TOTALS:	*****	**13**	**208**	**$49.905M**	**$3.75M**

Source: National Climatic Data Center *Many of the same events impacted all counties

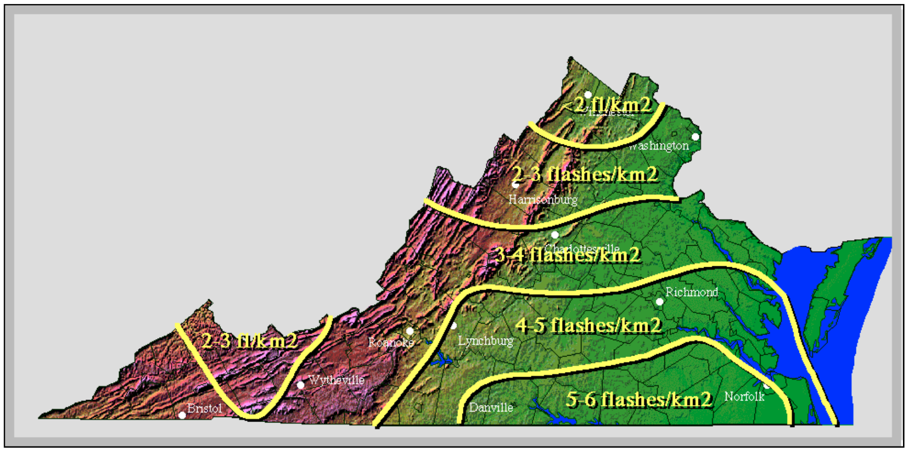
According to FEMA, the Rappahannock-Rapidan region was declared a major disaster area four times between 1995 and 2010 due to severe winter storms and snowstorms. All counties were impacted by these storms which occurred on February 5 – 11(2 storms), 2010; December 18 – 20, 2009; January 25-31, 2000; and January 13, 2006.

SEVERE THUNDERSTORMS AND TORNADOS

Thunderstorms

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. 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 5.14** 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.

Figure 5.14
Virginia Lightning Strike Density Map



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

Table 5.4
Significant Lightning Events: Rappahannock-Rapidan Region
01/01/1995 – 11/30/2010

Location	Number of Events	Deaths	Injuries	Property Damage*	Crop Damage*
Culpeper County	4	1	1	$30K	$0
Fauquier County	7	2	0	$56K	$3K
Madison County	2	0	0	$10	$0
Orange County	1	0	0	$1K	$0
Rappahannock County	2	0	0	$10K	$5K
REGIONAL TOTALS:	**16**	**3**	**1**	**$107K**	**$8K**

Source: National Climatic Data Center *** Approximate numbers based on NCDC records. ****

Table 5.5
Severe Thunderstorms and Associated Winds: Rappahannock-Rapidan Region

(01/01/1995- 12/31/2010) *

Location	Number of Events	Deaths	Injuries	Property Damage*	Crop Damage*
Culpeper County	67	0	0	301K	0
Fauquier County	143	0	15	1.43M	2K
Madison County	46	0	0	131K	0
Orange County	60	0	1	484K	5K
Rappahannock County	43	0	1	567K	0
REGIONAL TOTALS:		**0**	**16**	**2.913M**	**7K**

Source: National Climatic Data Center *** Approximate numbers based on NCDC records. ****

Additionally, 138 hail events are known to have occurred in the region since 1995 (NCDC, 2010). The number of events and amount of damage per county are summarized in Table 5.6.

Orange County Review; photo-Sandy James

Table 5.6
Hail Events in the Rappahannock-Rapidan Region
(01/01/1995- 12/31/2010) *

County	Number of Hail Events	Property Damage*	Crop Damage*
Culpeper	29	$90K	$20K
Fauquier	50	$2.001M	$0
Madison	13	$61K	$60K
Orange	27	$3K	$0
Rappahannock	19	$7K	$0
TOTALS:	**138**	**$2.162M**	**$80K**

Source: National Climatic Data Center * Approximate numbers based on NCDC records.

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.

Tornados

Virginia ranks 29th in the nation in the number of tornado events, 25th in tornado deaths, 26th in tornado injuries, and 28thin damages (Storm Prediction Center, 2003). From 1995 through March, 2011, the Rappahannock-Rapidan region experienced 35 tornado events.

Table 5.7
Tornados: Rappahannock-Rapidan Region (1995–2011)

County	Date	F-Scale	Deaths	Injuries	Property Damage	Crop Damage
Culpeper	09/20/2001	F0	0	0	0	0
	09/24/2001	F4	0	2	2M	0
	07/10/2003	F0	0	0	0	0
	09/08/2004	F1	0	0	50K	0
	09/17/2004	F1	0	0	850K	0
	09/17/2004	F1	0	0	150K	0
	08/30/2005	F0	0	0	5K	0
	06/04/2008	F0	0	0	15K	0
Total	**8**		**0**	**0**	**3.070M**	**0**
Fauquier	09/06/1996	F0	0	0	0	0
	09/24/2001	F1	0	0	20K	0
	09/24/2001	F1	0	0	180K	0
	05/07/2003	F1	0	0	12K	0
	09/08/2004	F2	0	0	500K	0
	09/08/2004	F1	0	0	7K	0
	09/08/2004	F0	0	0	2K	0
	09/17/2004	F3	0	2	250K	0
	09/17/2004	F2	0	0	500K	0
	09/17/2004	F2	0	0	750K	0
	08/30/2005	F0	0	0	50K	0
	08/30/2005	F1	0	0	1.5M	0
	06/04/2008	F0	0	0	15K	0
	06/04/2008	F0	0	0	15K	0
	03/13/2011	F1	0	0	0	0
Total	**15**		**0**	**2**	**3.811M**	**0**
Madison	09/17/1997	F1	0	0	15K	5K
	08/09/2000	F1	0	0	15K	0
	05/02/2004	F1	0	0	8K	0
	09/17/2004	F2	0	0	200K	0
	08/30/2005	F0	0	0	10K	5k
Total	**5**		**0**	**0**	**248K**	**5K**
Orange	07/21/1995	F1	0	0	80K	0
	09/10/1997	F0	0	0	0	0
	07/24/1999	F1	0	0	50K	0

County	Date	F-Scale	Deaths	Injuries	Property Damage	Crop Damage
	09/24/2001	F1	0	0	5K	0
	06/06/2002	F1	0	0	10K	0
	09/08/2004	F0	0	0	5K	0
	09/17/2004	F1	0	0	150K	0
	09/17/2004	F2	0	0	75K	0
Total	**8**		**0**	**0**	**375K**	**0**
Rappahannock	08/30/2005	F0	0	0	50K	0
	07/23/2008	F0	0	0	15K	0
Totals	**2**		**0**	**0**	**65K**	**0**
RRRC Total	**35**		**0**	**2**	**7.504M**	**5K**

Source: National Climatic Data Center

Figure 5.15 – 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 rated F2 or higher.

WILDFIRE

According to the Virginia Department of Forestry (VDOF), there were 354 recorded wildfires in the region from 1995-2010. 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. Total property damage was $212,613.00 with 1.4% of all events resulting in damage of $10,000 or more. Of particular interest is the value of property saved over this same time period - $59.3 M. 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:

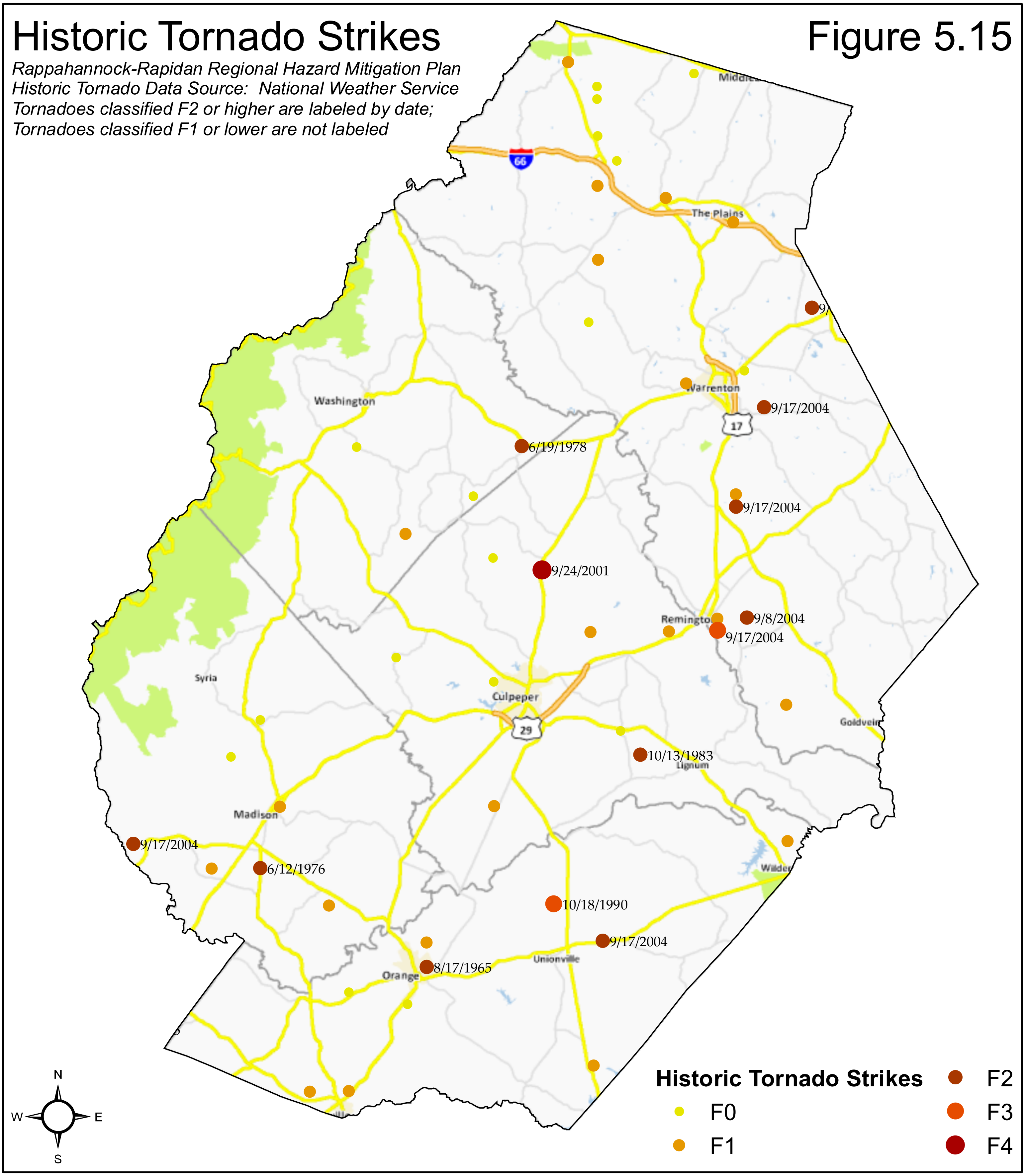
- Identify areas favorable to wildfire development and advancement;
- Examine the spatial relationship between high risk areas and woodland home communities, fire stations and fire hydrants;
- Identify areas requiring more detailed analysis.

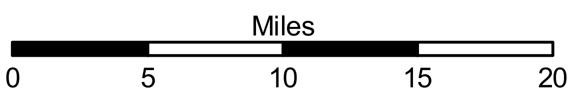
Figure 5.16 shows the Wildfire Risk Assessment in the region, according to the Virginia Department of Forestry. Within the Rappahannock-Rapidan region, Rappahannock and Madison counties are at greatest risk for wildfires. With heavily forested slopes marking their western boundaries, their proximity to the forests of Shenandoah National Park and relatively steep terrain, the two

Historic Tornado Strikes

Figure 5.15

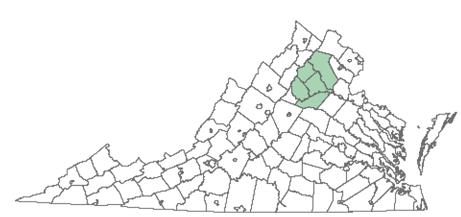
Rappahannock-Rapidan Regional Hazard Mitigation Plan
Historic Tornado Data Source: National Weather Service
Tornadoes classified F2 or higher are labeled by date;
Tornadoes classified F1 or lower are not labeled





Rappahannock-Rapidan
REGIONAL COMMISSION

Map created for Rappahannock-Rapidan Regional Hazard Mitigation Plan Update and is intended for general planning purposes only. Data is from various sources and may vary in accuracy and completeness.
Date: 2/21/2011 File: Historic_Tornado_Strikes.mxd



Wildfire Risk Assessment

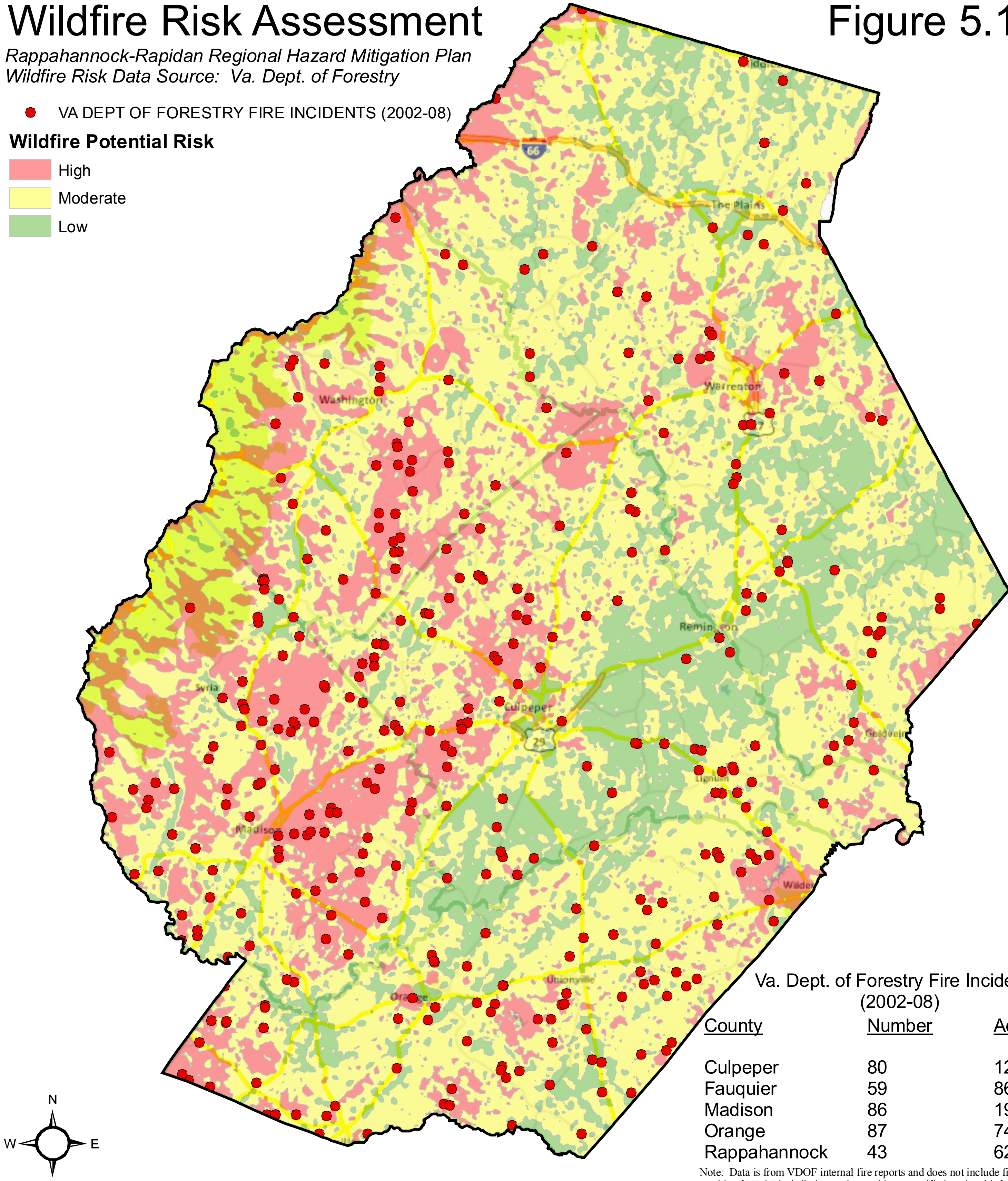
Figure 5.16

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Wildfire Risk Data Source: Va. Dept. of Forestry

● VA DEPT OF FORESTRY FIRE INCIDENTS (2002-08)

Wildfire Potential Risk

- High
- Moderate
- Low



Va. Dept. of Forestry Fire Incidents
(2002-08)

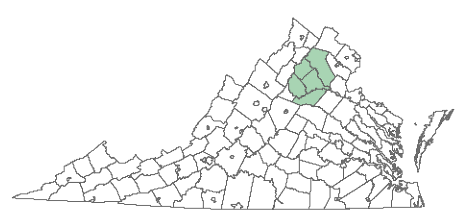
County	Number	Acres
Culpeper	80	126.0
Fauquier	59	86.5
Madison	86	194.6
Orange	87	74.2
Rappahannock	43	62.7

Note: Data is from VDOF internal fire reports and does not include fires outside of VDOF jurisdiction or those without specific locational information.

Rappahannock-Rapidan
REGIONAL COMMISSION

Miles
0 5 10 15 20

Map created for Rappahannock-Rapidan Regional Hazard Mitigation Plan Update and is intended for general planning purposes only. Data is from various sources and may vary in accuracy and completeness.
Date: 2/22/2011 File: Wildfire_Risk_Assessment.mxd



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 summarizes wildfire data for the region for the period 2005 – 2010, as recorded by the VDOF.

Table 5.8
Wildfire: Rappahannock-Rapidan Region
2005 - 2010

County	Events	Acres Impacted	Total Damage*	Value Total Saved*
Culpeper	69	209	$70,970	13.5M
Fauquier	60	171	$11,075	23.9M
Madison	81	110	$68,668	2.4M
Orange	98	169	$30,715	4.9M
Rappahannock	46	133	$31,185	14.6M
REGIONAL TOTALS:	**354**	**792**	**$212,613**	**59.3M**

Source: Virginia Department of Forestry *Estimates

DROUGHT

Since 1995, there have been several periods of drought recorded in the Rappahannock-Rapidan Region. The National Climatic Data Center attributes nearly $140 million in crop loss to these events.

Table 5.9
Drought: Rappahannock-Rapidan Region (1995–2010)

County	Dates Reported								
	8/95	7/97	8/98	11-12/98	5 - 9 /99	7-10/02	7/07	8/07	10/07
Culpeper	x		x	x	x	x			x
Fauquier	x	x	x	x	x	x	x	x	x
Madison	x		x	x	x	x	x	x	x
Orange	x			x	x	x	x	x	x
Rappahannock	x	x	x	x	x	x		x	x

Source: National Climatic Data Center

Significant Drought Event

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.

Table 5.10

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 5.11

Extreme Heat Events: Rappahannock-Rapidan Region (1995–2010)

Location	Number of Events
Culpeper County	16
Fauquier County	15
Madison County	14
Orange County	16
Rappahannock County	15
Regional Average:	**15**

Source: National Climatic Data Center

Regionally, 3 deaths and 230 illnesses were attributed to extreme heat during the period 1995 – 2010.

WINTER STORMS AND FREEZES

Most significant winter storms in the Rappahannock-Rapidan region are nor'easters (Section 5, p. 5). From 1995 to 2010 there have been about 72 significant winter storms resulting in 13 deaths and 208 injuries, along with $50 million in property damage and $3.75 million in crop loss.

Table 5.12
Significant Winter Storm Events: Rappahannock-Rapidan Region
01/01/1995 – 11/30/2010

Location	Number of Events	Deaths	Injuries	Property Damage*	Crop Damage*
Culpeper County	61	3	52	$9.85 M	$0
Fauquier County	81	4	52	$9.75M	$1.2M
Madison County	71	3	52	$10.73M	$1.275M
Orange County	64	1	1	$9.554M	$0
Rappahannock County	81	2	51	$10.025M	$1.275
REGIONAL TOTALS:	*	**13**	**208**	**$49.905M**	**$3.75M**

Source: National Climatic Data Center *Many of the same events impacted all counties

From 1995 through 2010, six extreme cold and wind-chill events were recorded. One death was attributed to extreme cold in January, 2007. Although $25, 000 in crop loss was attributed to unseasonably cold temperatures in March, 1998, no losses were directly related to extremely cold temperatures.

EROSION (SEE LANDSLIDES)

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.

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. 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, while Individual Assistance (assistance to individuals and households) designations were provided by FEMA for Culpeper and Orange counties.

FIGURE 5.17– SEISMIC ZONES IN VIRGINIA

GILES COUNTY SEISMIC ZONE - PINK; CENTRAL PIEDMONT SEISMIC ZONE – YELLOW | SOURCE: VIRGINIA DMME

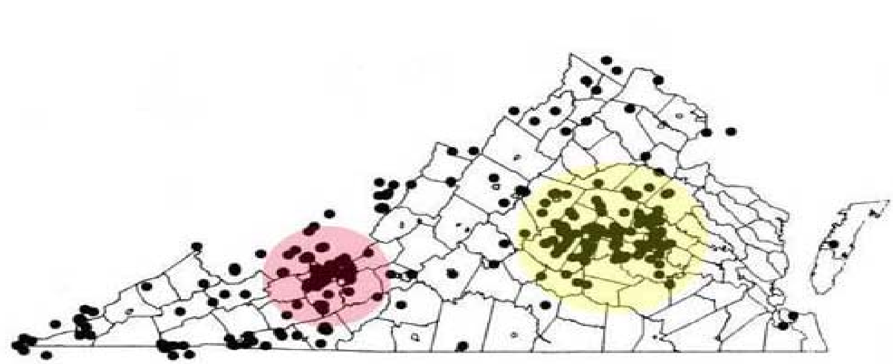


FIGURE 5.18 – SEISMICITY OF VIRGINIA, 1990 - 2006

CIRCLES = EARTHQUAKES (DEPTH IN KM INDICATED BY COLOR) | SOURCE: USGS

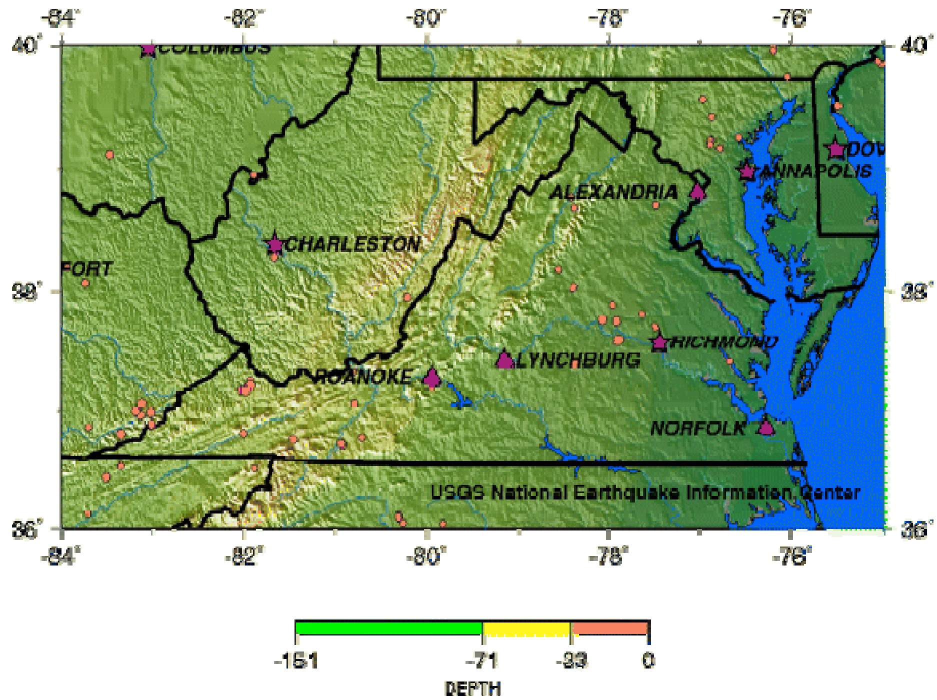
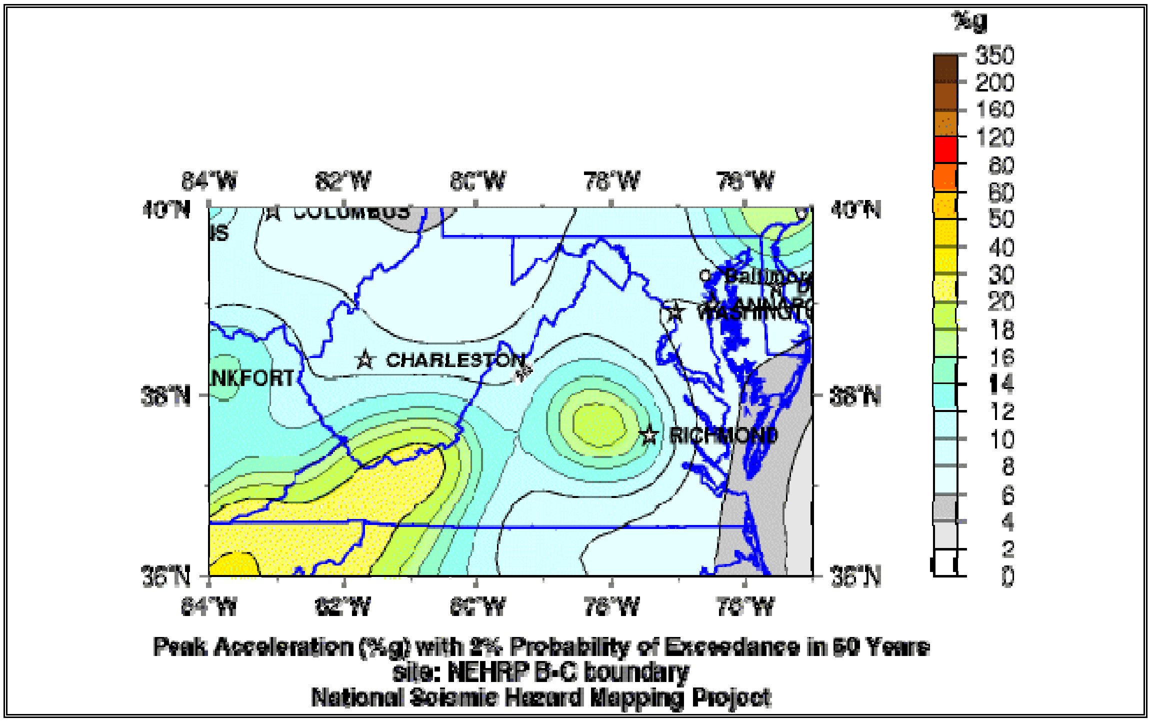


Figure 5.19
Geological and Seismic Information for Virginia



Source: USGS National Seismic Hazard Mapping Project

Figure 5.20 summarizes the expected earthquake intensity levels with 10 percent probability of exceedence in 50 years[4] based on the national U.S. Geological Survey map of peak acceleration. 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.

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 5.13**).

Table 5.13
Significant Seismic Events Impacting the Rappahannock-Rapidan Region

1774 - 1984

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

Source: National Geophysical Data Center

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

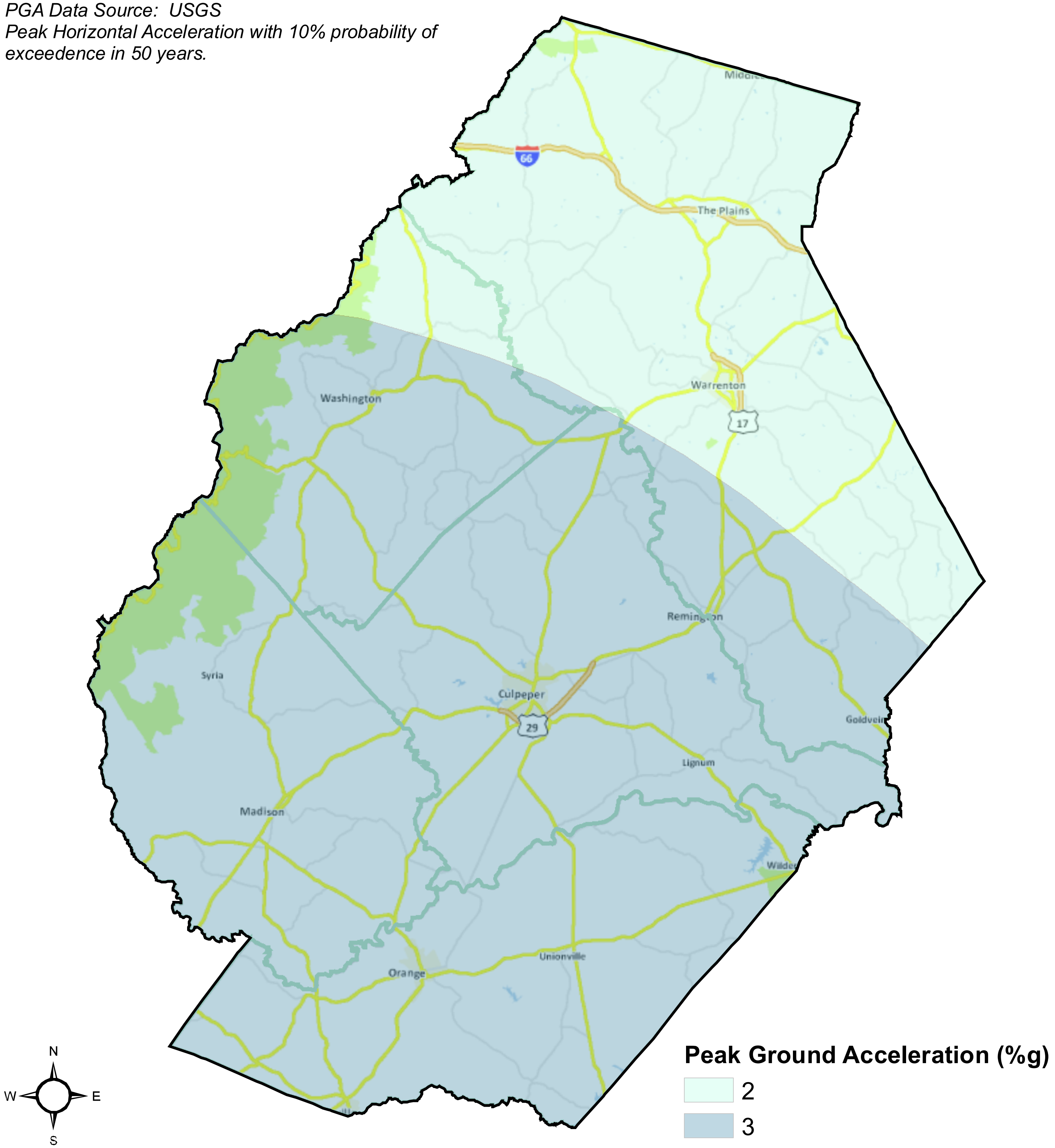
Landslides are Virginia's most widespread geologic hazard. The most disastrous landslide events are associated with heavy rainfall along the steep slopes of the Blue Ridge Mountains and the Appalachians, but slumping, sliding, and creep can occur even on fairly gentle slopes if local conditions exceed 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

[4] This national base map is presented and discussed in the *Hazard Identification* section of this Plan. The zones indicated on the regional map are based on the national map.

Earthquake: Peak Ground Acceleration

Figure 5.20

Rappahannock-Rapidan Regional Hazard Mitigation Plan
PGA Data Source: USGS
Peak Horizontal Acceleration with 10% probability of exceedence in 50 years.



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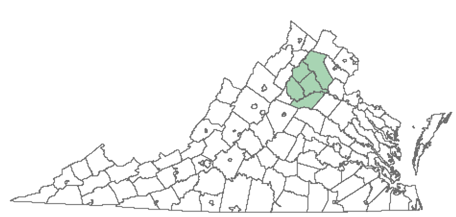
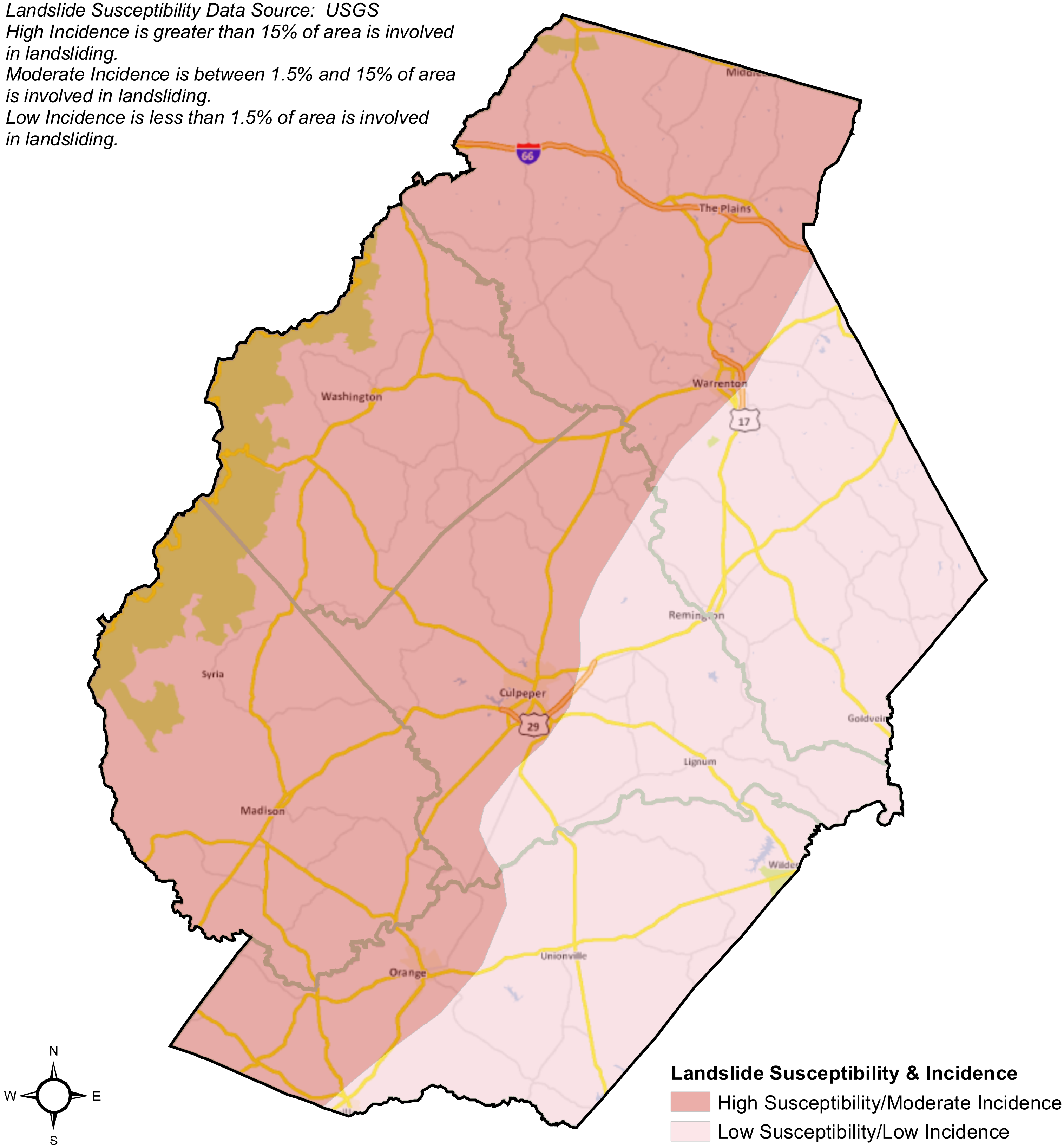
Map created for Rappahannock-Rapidan Regional Hazard Mitigation Plan Update and is intended for general planning purposes only. Data is from various sources and may vary in accuracy and completeness.
Date: 5/10/2011 File: EQ_Peak_Ground_Acceleration.mxd



Landslide Susceptibility & Incidence

Figure 5.21

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Landslide Susceptibility Data Source: USGS
High Incidence is greater than 15% of area is involved in landsliding.
Moderate Incidence is between 1.5% and 15% of area is involved in landsliding.
Low Incidence is less than 1.5% of area is involved in landsliding.



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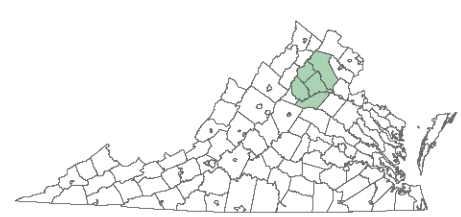
Date: 5/10/2011 File: Landslide_Susceptibility.mxd

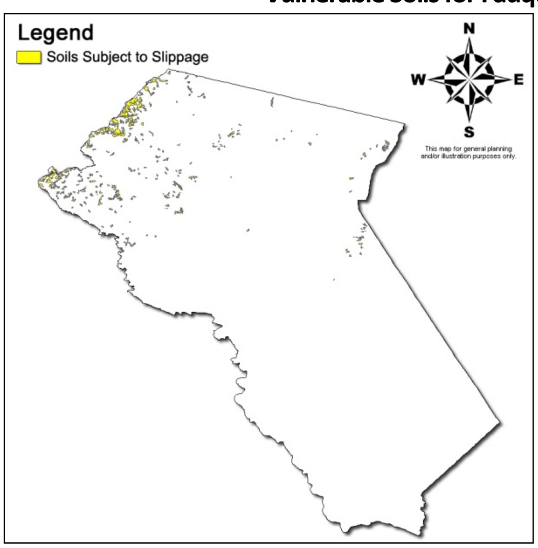


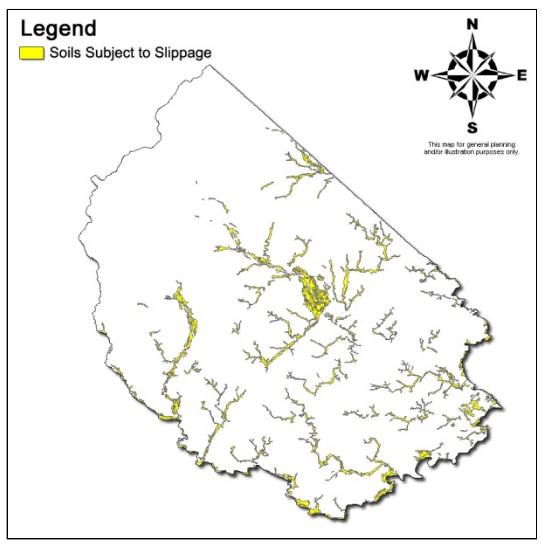
revealed that about fifty-six percent of recent landslides occurred on slopes that had been altered in some way by development.

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[5], the region is split between a zone of high susceptibility/moderate incidence and low incidence (**Figure 5.21**).

LEFT: 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
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.

[5] This national base map is presented and discussed in the *Hazard Identification* section of this risk assessment. The terms used here are more thoroughly defined in that section.

DAM/LEVEE 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 or levee 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;
- Improper design, material selection; and/or construction;
- Negligent operation;
- Failure of upstream structure(s);
- High winds creating erosion by wave action;
- Intentional criminal acts.

Virginia's recent (2008) 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.

Table 5.14
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.

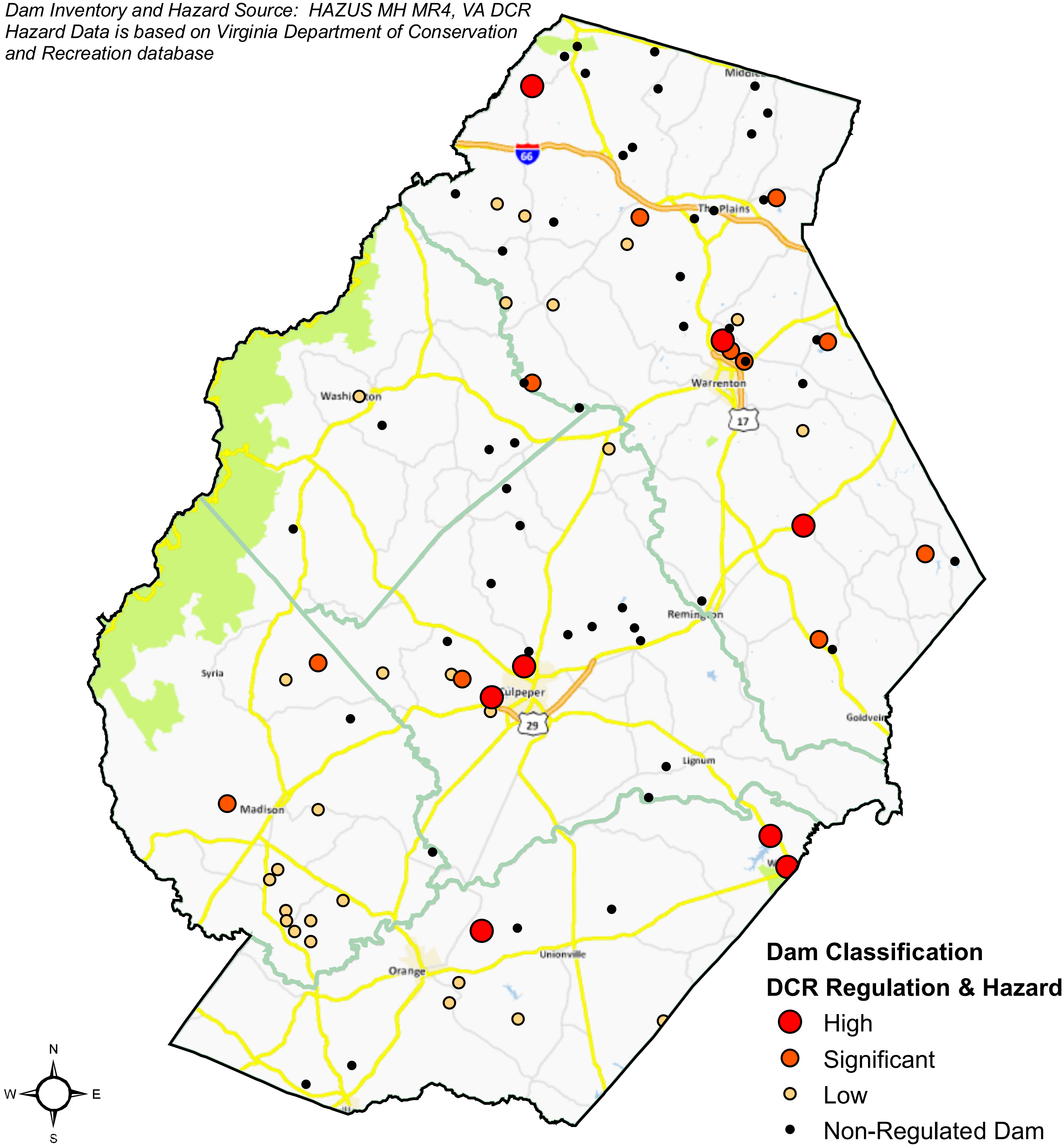
The owner of each regulated dam, whether high, significant or low hazard, is required to obtain an Operation and Maintenance Certificate. This must include an assessment of the dam by a licensed professional and an Emergency Action Plan which must be filed with the appropriate local emergency official 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.

There are no comprehensive databases of historical dam failures in Virginia. According to the Virginia Department of Conservation and Recreation there are 48 state regulated dams in the Rappahannock-Rapidan region. Of those, 8 are classified as high hazard potential, 13 are significant and 27 are low (see Figure 5.23 – Dam Classification).

Dam Inventory & Classification

Figure 5.23

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Dam Inventory and Hazard Source: HAZUS MH MR4, VA DCR
Hazard Data is based on Virginia Department of Conservation and Recreation database



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Date: 6/2/2011 File: Dam_Classification.mxd

Table 5.15: Regulated Dams – by County

Culpeper	Hazard Potential			Classification		
	High	Significant	Low	MC	MR	OC
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	
South Wales			x	x		
Cole 1			x		x	
Troiano		x		x		
TOTALS:	**2**	**2**	**4**	**4**	**4**	
Fauquier						
Warrenton		x			x	
DiGiulian			**x**	x		
Thompson	**x**			x		
Kinloch Farm		**x**			x	
Springhill Farm			**x**	x		
Barr			**x**	x		
Johnson		**x**		x		
Clifton Lower			x	x		
Coventry		x		x		
Mellott		x				x
Lake Brittle		x		x		
Winslow		x			x	
Hideaway Hills			x		x	
Warrenton Lakes - Lower		x		x		
Licking Run	x				x	
Cedar Run 3	x				x	
Willow Pond Farm			x		x	
Volgenau			x		x	
TOTALS:	**3**	**8**	**7**	**9**	**8**	**1**

Madison	Hazard Potential			Classification		
	High	Significant	Low	MC	MR	OC
White Oak		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		
Beautiful Run 1B			x		x	
Hablutzel			x		x	
Malvern			x	x		
Deep Run Farm		x			x	
Totals		**2**	**10**	**4**	**8**	
Orange						
Lake of the Woods	x				x	
Lake Orange			x		x	
Grymes Mill			x	x		
Northrup			x		x	
Keaton's Run	x				x	
James A. Strong			x		x	
Decoursey			x		x	
Spring Vale	x			x		
Orange Raw Water Reservoir		x				
Totals	**3**	**1**	**5**	**2**	**6**	
Rappahannock						
Whippoorwill			x		x	
Totals			**1**		**1**	
REGION TOTALS:	**8**	**13**	**27**	**19**	**27**	**1**

Source: Virginia Department of Conservation and Recreation – Division of Dam Safety, May 2011

DATA SOURCES

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/

VULNERABILITY ASSESSMENT

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. All assessments are based on best available data.

44 CFR 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.

Natural Hazards

- **Flood**
- **Hurricanes and Tropical Storms**
- **Severe Thunderstorms and Tornadoes**
- **Wildfire**
- **Drought/Extreme Heat**
- **Winter Storms**
- **Earthquakes**
- **Landslides**
- **Dam/Levee Failure**

ASSESEMENT METHODOLOGIES

Assessment tools used include:

- HAZUS®MH MR4;
- GIS (Non-HAZUS) Risk Assessment; and
- Mitigation scorecard

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.

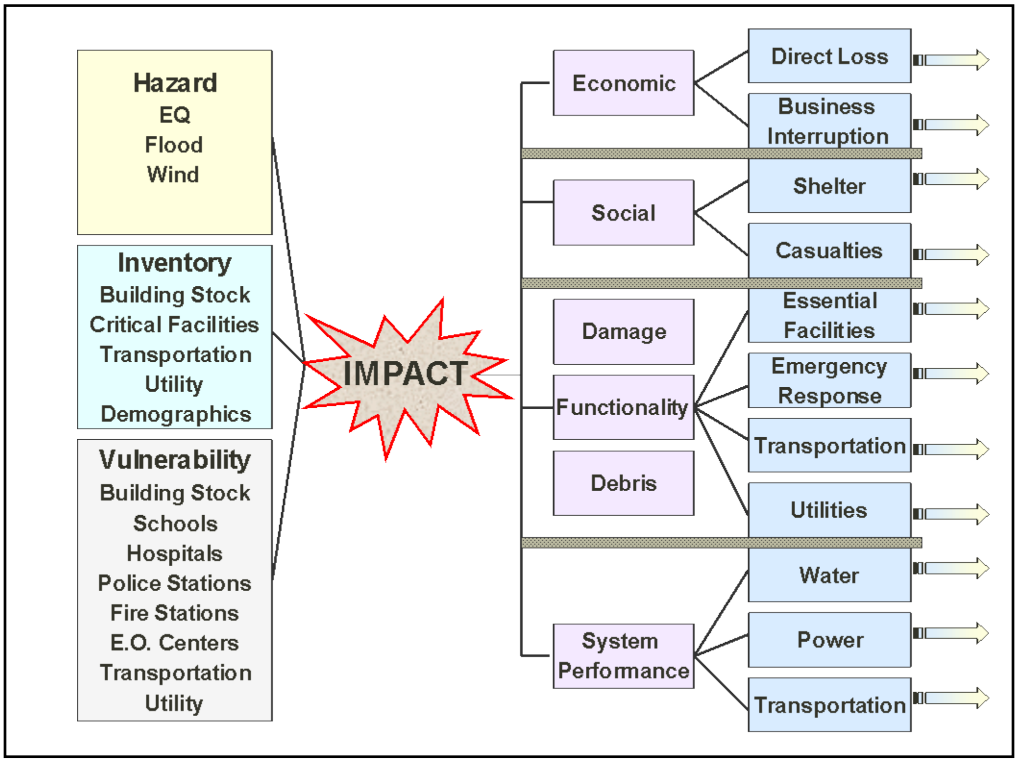
It should be noted that the vulnerability determinations presented in this section are based on best available data and represent an approximation of risk. While useful in understanding relative risk and potential loss, all such analyses include inherent uncertainty reflecting incomplete knowledge and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

HAZUSMH Risk Assessment Methodology

HAZUSMH is FEMA's nationwide standardized loss estimation software package, built on an integrated GIS platform. In this risk assessment, HAZUSMH 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 HAZUSMH MR4 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 HAZUSMH software to determine the impact (damages and losses) on the built environment. **Figure 6.1** shows a conceptual model of HAZUSMH methodology.

Figure 6.1
Conceptual Model of HAZUS^{MH} Methodology



It is important to note that for those hazards where HAZUS^{MH} 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.

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

The general steps used in the GIS-based assessment conducted independently of the HAZUS^{MH} software are summarized below:

- In addition to the HAZUS^{MH} MR4 analysis for the region's flood vulnerability, a spatial analysis utilizing ESRI ArcGIS 9.3.1 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 commentary, 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 2010 the population of the Rappahannock-Rapidan Region was 166,054, a 23% increase from 2000. Virginia's population in 2010 was 8,001024, having increased by 13.02% since 2000 when it was 7,079,048. The average number of persons per square mile in the Rappahannock-Rapidan region in 2010 was 85 (**Fig. 6.2 – Population Density**), an increase of 12 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 $15,125,256,000. This is based on HAZUS^{MH} MR4 inventories of 60,407 residential, commercial, industrial and other buildings located within the region.[1] Total dollar exposure accounts for both the building and its contents, which is based on a percentage of the building's value. **Figures 6.3** through **6.5** show the distribution of residential, commercial and industrial property exposure throughout the county by census tract.[2]

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^{MH}.

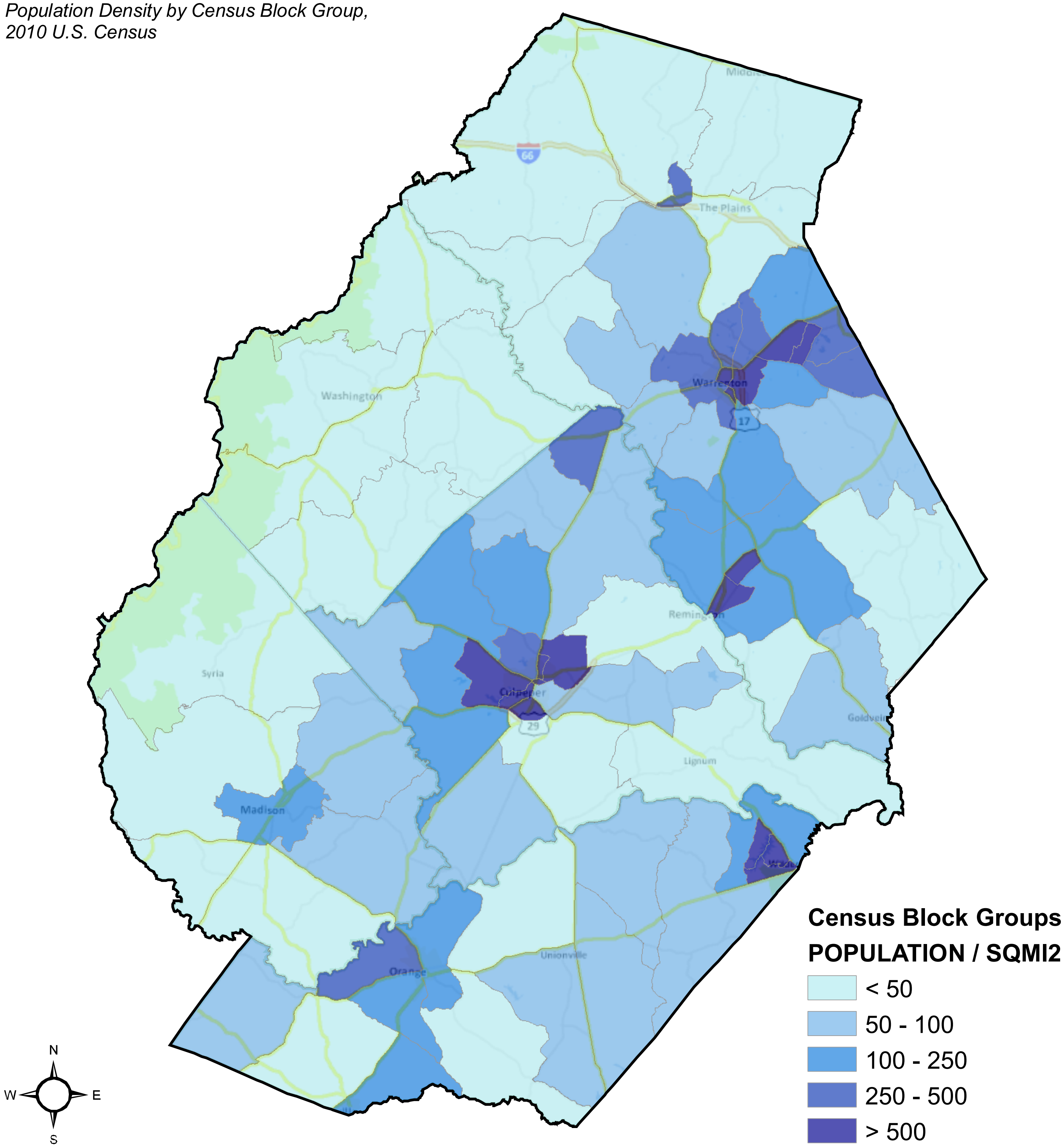
Table 6.2
Critical Facilities in the Rappahannock-Rapidan Region (HAZUS^{MH} Inventory and Local Input)

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
Culpeper	Brandy Station	Brandy Volunteer Fire Dept	Fire Station
Culpeper	Culpeper	Salem Volunteer Fire & Rescue	Fire Station

[1] HAZUS^{MH} MR4 uses U.S. Census, Dunn & Bradstreet (2006) and R.S. Means (2006) data for its default inventories. Values not reflected in HAZUS^{MH} MR4 are not reflected.
[2] The remaining 1 percent is classified as "other" and includes agriculture, education, government and religious buildings.

Population Density | 2010 U.S. Census Figure 6.2

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Population Density by Census Block Group,
2010 U.S. Census



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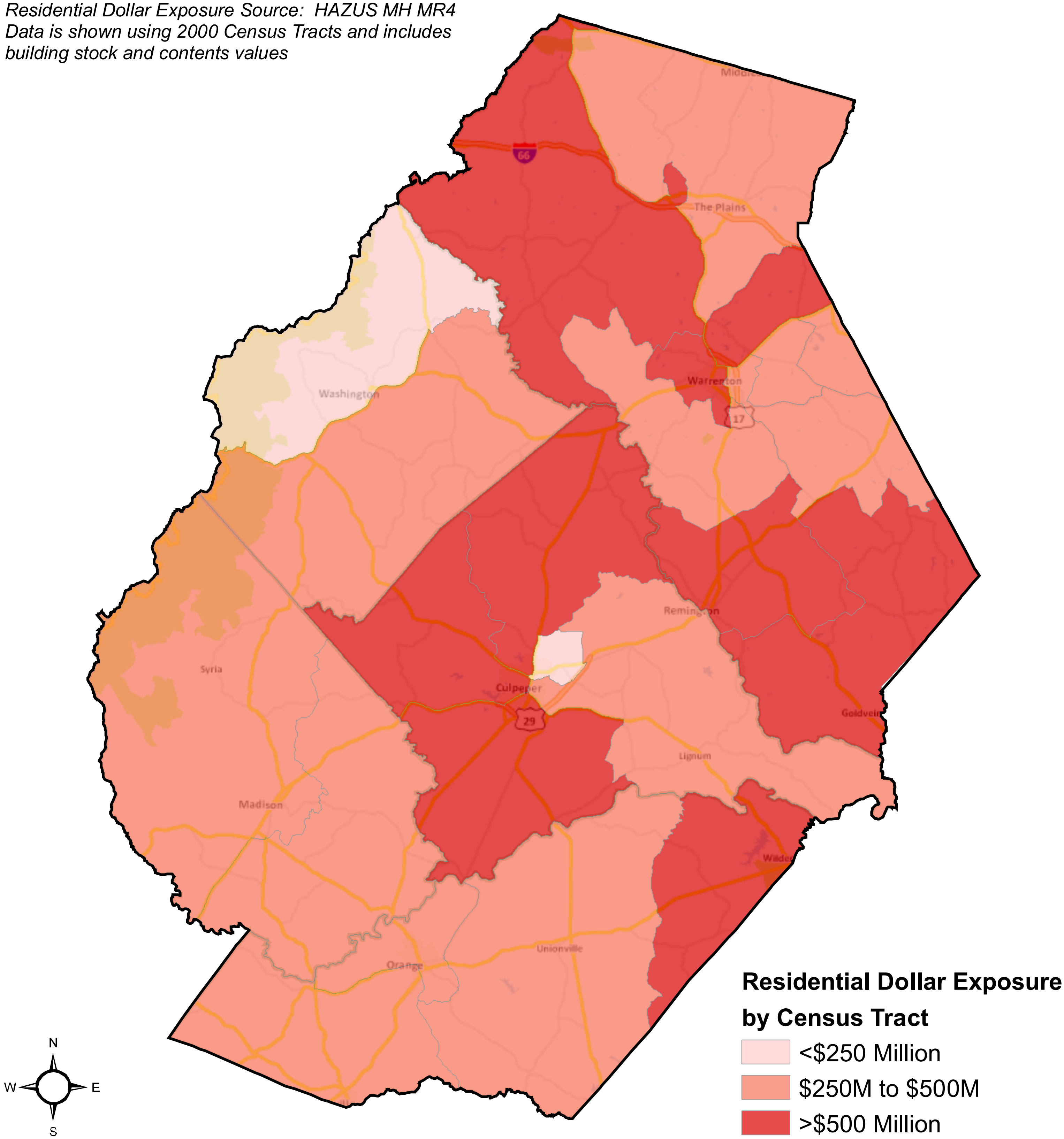
Date: 6/1/2011 File: RRRC_Pop_Density.mxd

Residential Exposure by Census Tract

Figure 6.3

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Residential Dollar Exposure Source: HAZUS MH MR4
Data is shown using 2000 Census Tracts and includes building stock and contents values



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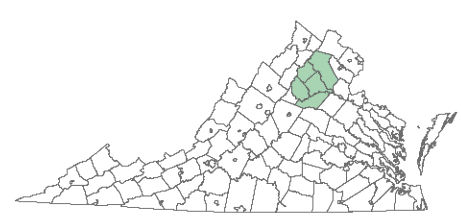
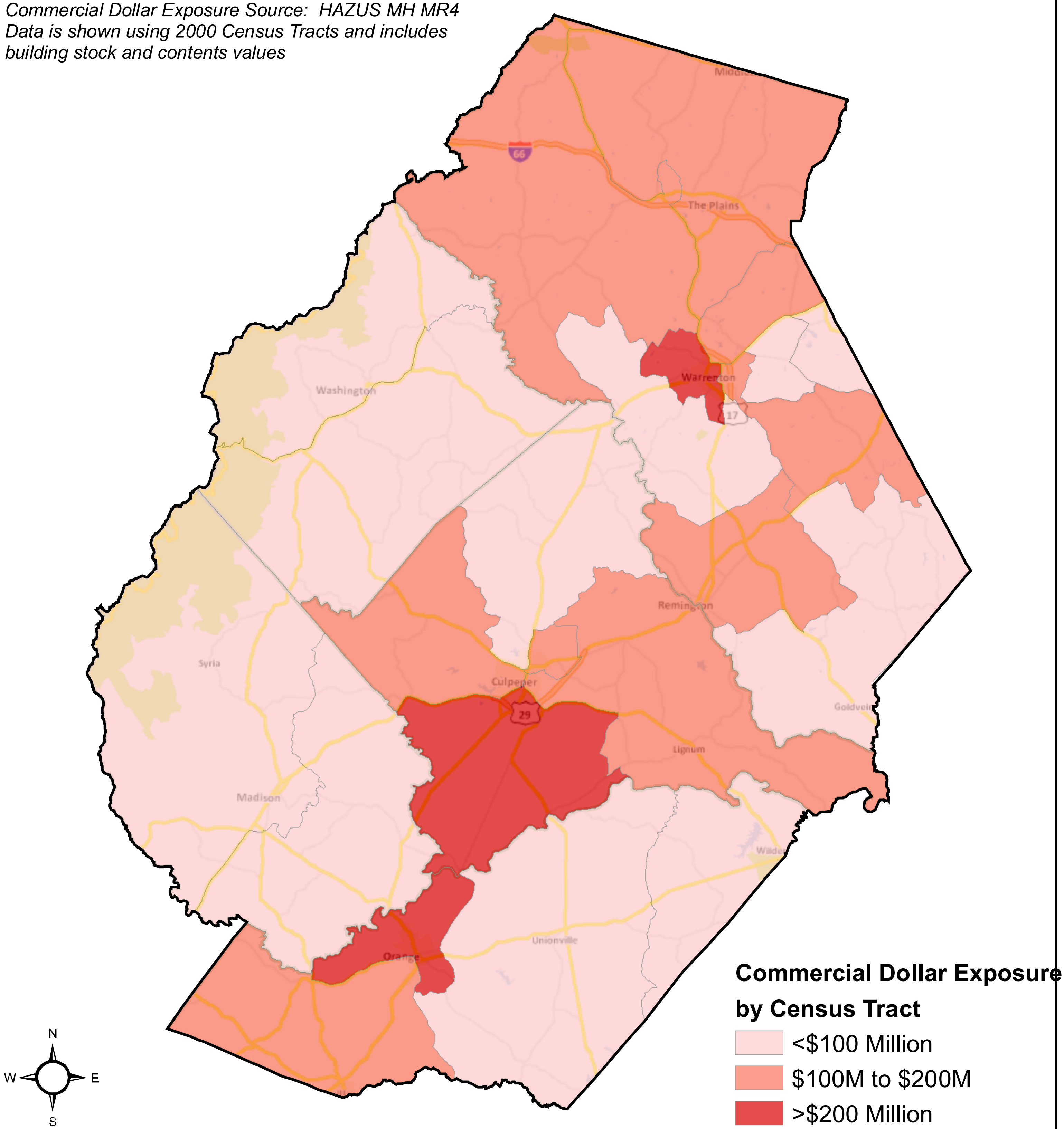


Commercial Exposure by Census Tract Figure 6.4

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Commercial Dollar Exposure Source: HAZUS MH MR4
Data is shown using 2000 Census Tracts and includes building stock and contents values



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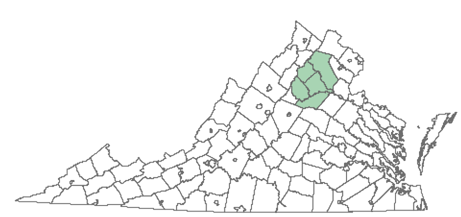
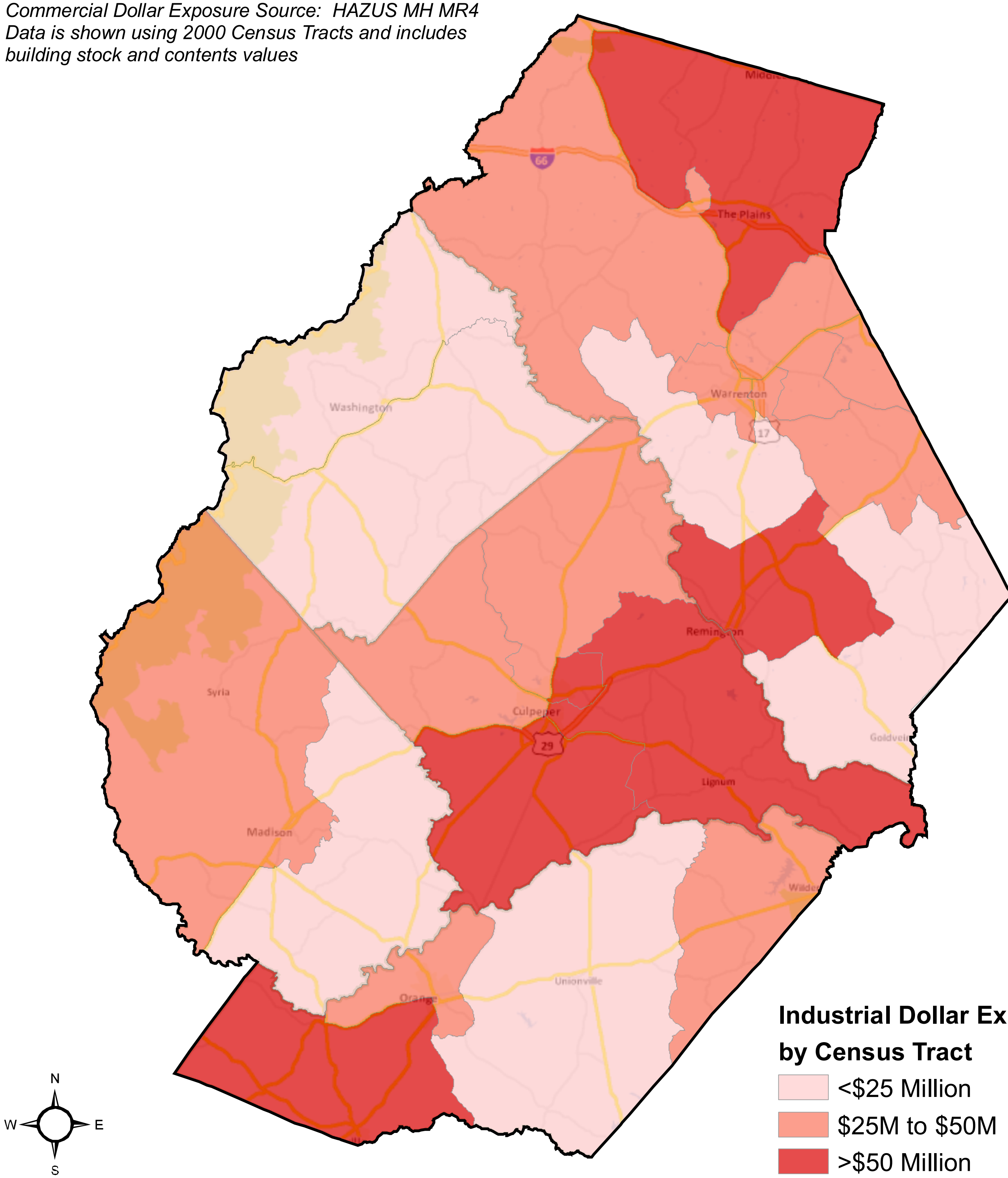
Map created for Rappahannock-Rapidan Regional Hazard Mitigation Plan Update and is intended for general planning purposes only. Data is from various sources and may vary in accuracy and completeness.
Date: 6/2/2011 File: Commercial_Exposure.mxd



Industrial Exposure by Census Tract

Figure 6.5

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Commercial Dollar Exposure Source: HAZUS MH MR4
Data is shown using 2000 Census Tracts and includes building stock and contents values



Industrial Dollar Exposure by Census Tract

- <$25 Million
- $25M to $50M
- >$50 Million

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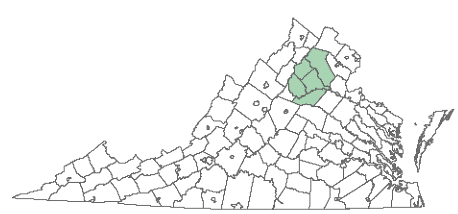
Date: 6/2/2011 File: Industrial_Exposure.mxd

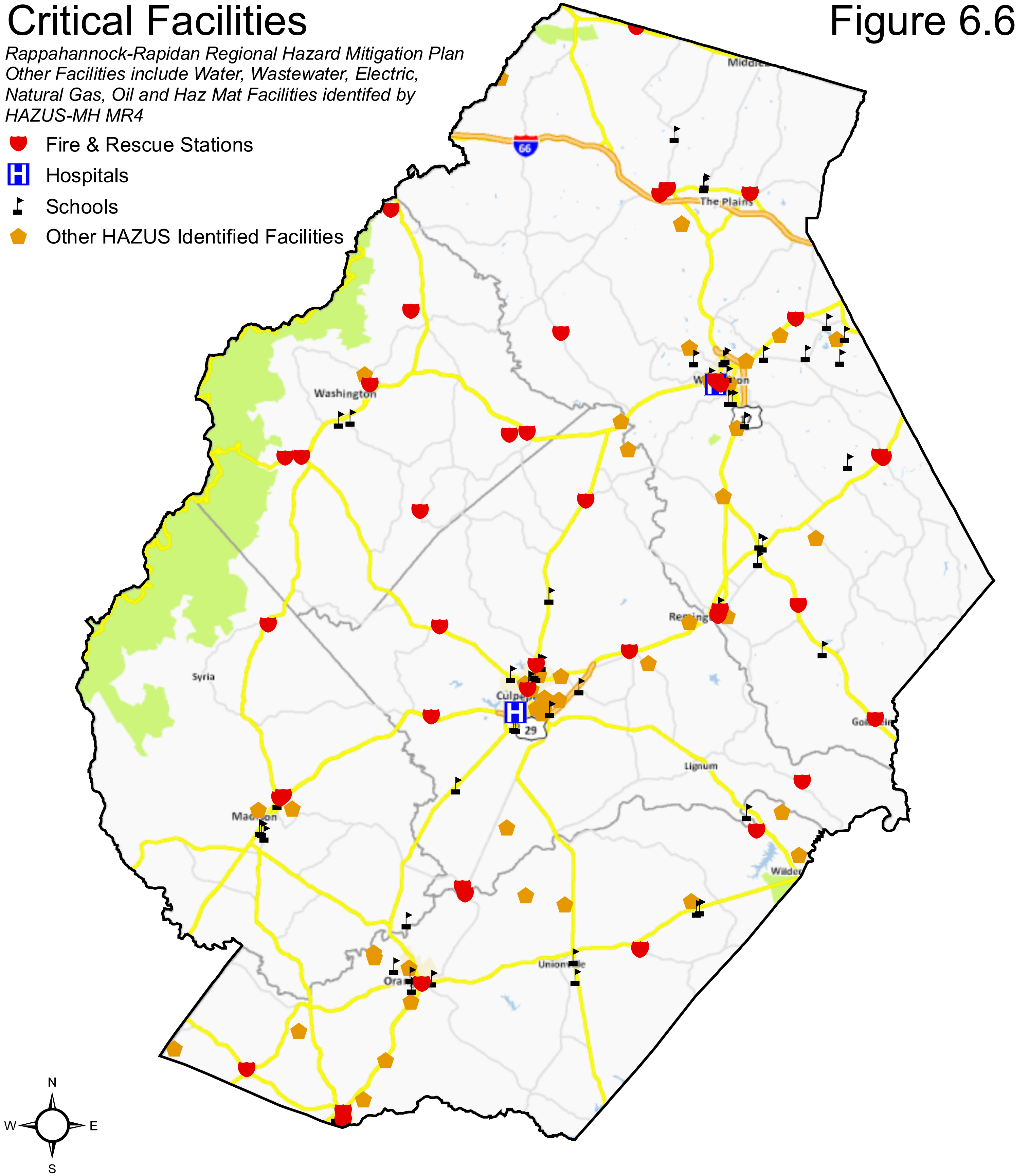


Critical Facilities

Figure 6.6

Rappahannock-Rapidan Regional Hazard Mitigation Plan
Other Facilities include Water, Wastewater, Electric, Natural Gas, Oil and Haz Mat Facilities identifed by HAZUS-MH MR4

- Fire & Rescue Stations
- Hospitals
- Schools
- Other HAZUS Identified Facilities



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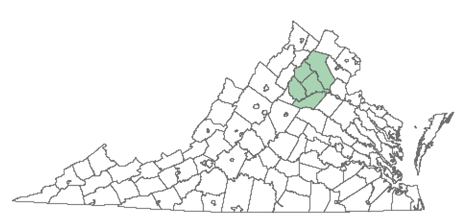
Date: 2/21/2011 File: Critical_Facilities.mxd



County	Jurisdiction	Facility Name	Facility Type
Culpeper	Culpeper	Culpeper County Sheriff's Office	Police Station
Culpeper	Culpeper	Culpeper Police Dept	Police Station
Culpeper	Culpeper	Culpeper Christian School	School
Culpeper	Culpeper	St. Luke's Lutheran School	School
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	Culpeper	Emerald Hill Elementary	School
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	CFREM 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

County	Jurisdiction	Facility Name	Facility Type
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
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

County	Jurisdiction	Facility Name	Facility Type
Fauquier	Catlett	H. M. Pearson Elementary	School
Fauquier	Marshall	Marshall Middle	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
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 (9 facilities)	Daycare
Fauquier	Warrenton	Children of America	Daycare
Fauquier	Bealeton	Children of America	Daycare
Fauquier	Warrenton	Jack and Jill	Daycare
Fauquier		Maplewood Childcare Center	Daycare

County	Jurisdiction	Facility Name	Facility Type
Fauquier		Piedmont Child Development Center	Daycare
Fauquier	Bealeton	Southern Fauquier Child Development	Daycare
Fauquier	Multiple locations	Walnut Grove Childcare Facility	Daycare
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	Oak Springs Nursing Home	Nursing Home
Fauquier	Warrenton	Overlook Nursing Home	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
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

County	Jurisdiction	Facility Name	Facility Type
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 Menonite School	School
Madison	Madison	Madison County High	School
Madison	Madison	Madison Primary	School
Madison	Madison	Waverly Yowell Elementary	School
Madison	Madison	William H. Wetsel Middle	School
Madison	Criglersville	Criglesrville 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

County	Jurisdiction	Facility Name	Facility Type
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	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
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	Town of Orange Public Works Facilities	Government Building
Orange	Orange	Town of Orange Administrative Building	Government Building

County	Jurisdiction	Facility Name	Facility Type
Orange	Orange	Orange County Courthouse	Government Building
Orange	Multiple Locations	County Administrative Buildings	Government Building
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	President Madison Inn	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	W.A. Brockman Oil Company	Fueling Station
Rappahannock	Washington	Sheriff's Office	Police Station
Rappahannock	Castleton	Massanova Christian Academy	School
Rappahannock	Flint Hill	Wakefield Country Day School	School
Rappahannock	Washington	Rappahannock County High	School
Rappahannock	Washington	Rappahannock Elementary	School

County	Jurisdiction	Facility Name	Facility Type
Rappahannock	Washington	Rappahannock Office of Emergency Management	Emergency Management Office
Rappahannock	Washington	Rappahannock County Courthouse	Government Building
Rappahannock	Washington	Rappahannock County Administrative Buildings	Government Building
Rappahannock	Washington	Co 1 Fire and Rescue	Fire Department
Rappahannock	Flint Hill	Flint Hill Volunteers Fire	Fire Department
Rappahannock	Sperryville	Co 2 Fire and Rescue	Fire Department
Rappahannock	Amissville	Co 3 Fire and Rescue	Fire Department
Rappahannock		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	Sperryville	Hearthstone School	School
Rappahannock	Washington	Child Care and Learning Center	Day Care
Rappahannock	Washington	Rappahannock County Co-Op	Co-Op

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 Flood Model analysis returned 130 reaches in the Rappahanock-Rapidan region, which were in turn divided into six scenarios in order to minimize processing time for the hydraulics analysis. The HAZUS analysis returned an annualized loss estimate of $31,250,000 for the Rappahannock-Rapidan study region.

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*,[3] 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 10,141 parcels within the region have been identified through GIS analysis as intersecting with the 100-year floodplain. Of these parcels, 6,044 were identified as having

[3] Maps showing the spatial extent of flooding in the Rappahannock-Rapidan Region including all five counties and the municipalities of Culpeper, Gordonsville, Warrenton, and Remington, based on floodplain data from FEMA and the localities in the region are shown under "Flood" in the *Hazard Analysis* section (Section 5 of this Plan).

improvements on the property. The total improvements on these parcels intersecting the 100-year floodplain amounted to an assessed value of $1,678,275,300.

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 1,052 structures that are located in the floodplain. These "floodplain structures" amount to an assessed value of $188,472,700.

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 Intersecting Floodplain	Assessed Value	Annualized Losses
Culpeper County	7/1/87	6/18/07	1,422	74	108	$56,096,200	$560,962
Culpeper	3/2/89	6/18/07	505	132	154	$47,729,600	$477,296
Fauquier County	11/1/79	2/6/08	5,358	189	210	$39,207,000	$392,070
Remington	3/18/80	2/6/08	278	89	125	$6,595,600	$65,956
The Plains	NP		10	0	0	$0	$0
Warrenton	8/1/79	2/6/08	149	13	29	$2,984,100	$29,841
Madison County	4/3/89	1/5/07	796	118	276	$25,338,600	$253,386
Madison	NSHA	None	0	0	0	$0	$0
Orange County	9/10/84	1/2/08	867	19	36	$4,692,400	$46,924
Gordonsville	NP		28	5	6	$686,300	$6,863
Orange	1/2/08	1/2/08	0	0	0	$0	$0
Rappahannock County[4]	8/24/84	1/5/07	715	71	108	$5,142,900	$51,429
Washington	1/5/07	1/5/07	13	0	0	$0	$0
REGIONWIDE TOTALS			**10,141**	**710**	**1,052**	**$188,472,700**	**$1,884,727**

*Total value of all parcels intersecting the floodplain.

Annualized Losses for Flood

The HAZUS^{MH} MR4 Flood Hazard Riverine Analysis generated an annualized loss estimate of $31,250,000 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).

[4] The digital data layers for Rappahannock County do not overlay exactly with each other. The analysis was performed anyway, using this inaccurate data. In order to determine the flood hazard risk more accurately, better data should be developed.

Table 6.5 - HAZUS[MH] 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	5,642	4,732	65	1	0	7	0	10,447
Fauquier	6,472	5,441	113	2	1	11	0	12,040
Madison	1,421	1,018	14	0	0	1	0	2,454
Orange	2,140	2,410	82	0	0	7	0	4,639
Rappahannock	922	738	10	0	0	0	0	1,670
R-R Region	16,597	14,339	284	3	1	26	0	31,250

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 $16,782,753.

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 $1,884,727.

National Flood Insurance Program Data

As of February 28, 2011, there were 406 properties enrolled in the National Flood Insurance Program in the Rappahannock-Rapidan Region. These policies amounted to $285,643.00 in total premiums and $10,102,390.00 in total insurance coverage (**Table 6.6).**

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

Community Name	Policies in force	Insurance in force, whole	Premiums in force
Culpeper County	35	$9,003,100.00	$16,725.00
Culpeper	39	$9,970,500.00	$23,405.00
Fauquier County	123	$30,953,900.00	$94,970.00
Remington	46	$8,745,000.00	$36,671.00
Warrenton	24	$6,355,300.00	$19,566.00
Madison County	43	$9,423,900.00	$27,668.00
Madison	0		
Orange County	51	$14,385,200.00	$23,797.00
Gordonsville	0		
Orange	2	$630,000.00	$738.00
Rappahannock County	43	$11,557,000.00	$42,103.00
Washington	0		
REGION TOTALS:	**406**	**$10,102,390.00**	**$285,643.00**

Data as of 2/28/2011

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. Under the NFIP, FEMA defines a repetitive loss property as "any NFIP-insured property that, since 1978 and regardless of any change(s) of ownership during that period, has experienced: a) four or more paid flood losses; or b) two paid flood losses within a 10-year period that equal or exceed the current value of the insured property; or c) three or more paid losses that equal or exceed the current value of the insured property." 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.

According to FEMA, there are currently 5 repetitive loss properties within the jurisdictions of the Rappahannock Rapidan Region (**Table 6.7**).[5] 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.[6]

Table 6.7
NFIP Repetitive Loss Properties in the Rappahannock Rapidan Region

Jurisdiction	Flood Zone	Number of Insured Losses	Total NFIP Claims Paid	Mitigated?
Madison	AE	2	$19,668	No
Madison	AE	2	$38,011	No
Culpeper	A	2	$46,864	No
Orange	A	2	$69,790	No
Warrenton	A	2	$15,795	No
TOTAL		**10**	**$190,131**	

Source: Federal Emergency Management Agency

HURRICANES AND TROPICAL STORMS

Historical evidence shows that the Rappahannock-Rapidan Region is vulnerable to damaging hurricane and tropical storm-force winds.[7] 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).[8] **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 $139,000 was derived from the HAZUS^{MH} assessment.

[5] Data from FEMA was provided to R-RRC officials by the Virginia Division of Emergency Management.
[6] NFIP repetitive loss data is protected under the federal Privacy Act of 1974 (5 U.S.C. 552a) which prohibits personal identifiers (i.e., owner names, addresses, etc.) from being published in local mitigation plans.

[7] Refer to the *Hazard Analysis* section of this risk assessment for detailed historical information.
[8] According to FEMA's HAZUS Web site, "a Level 1 analysis yields a rough estimate based on the nationwide database and is a great way to begin the risk assessment process and prioritize high-risk communities."

Table 6.8
HAZUS^{MH} Estimates of Potential Losses for Hurricane-force Winds

Level of Event	Approximate Number of Structures Damaged	Estimated Losses
50-year Storm	14	$180,000
100-year Storm	33	$1,586,000
500-year Storm	1,236	$16,132,000

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 $13,672,365,000 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 $351,800 was generated for severe thunderstorms. A regional annualized loss of $500,600 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.

DROUGHT

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 $140 million in crop loss to these events. However, it should be noted that those total losses are for all counties included in the NCDC database of the event and often include many counties outside of the Rappahannock-Rapidan region. In the NCDC database, the value associated with each event is not broken down by county so it is difficult to determine separate annualized losses by county. 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 for drought. Based upon the events discussed in the *Hazard Analysis* section, the regional annualized loss estimate for the Rappahannock-Rapidan Region is $2,046,333. The majority of that value is for losses to crops and farmlands caused by drought events from 1995 to 2010.

The annualized loss estimate for drought is 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.

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 $167,864[9] 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.

EROSION

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 will attempt to address erosion vulnerability in greater detail.

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

[9] The winter storm annualized loss estimate includes damages associated with nor'easters.

region since 1974, all with magnitude less than 3.2 on the Richter Scale. Using HAZUS^{MH} MR4's probabilistic earthquake modeling program, an annualized loss estimate of $240,000 was derived for the Rappahannock-Rapidan region.

The August 23, 2011 earthquake had an epicenter in Mineral, Louisa County, Virginia, located outside 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.

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.

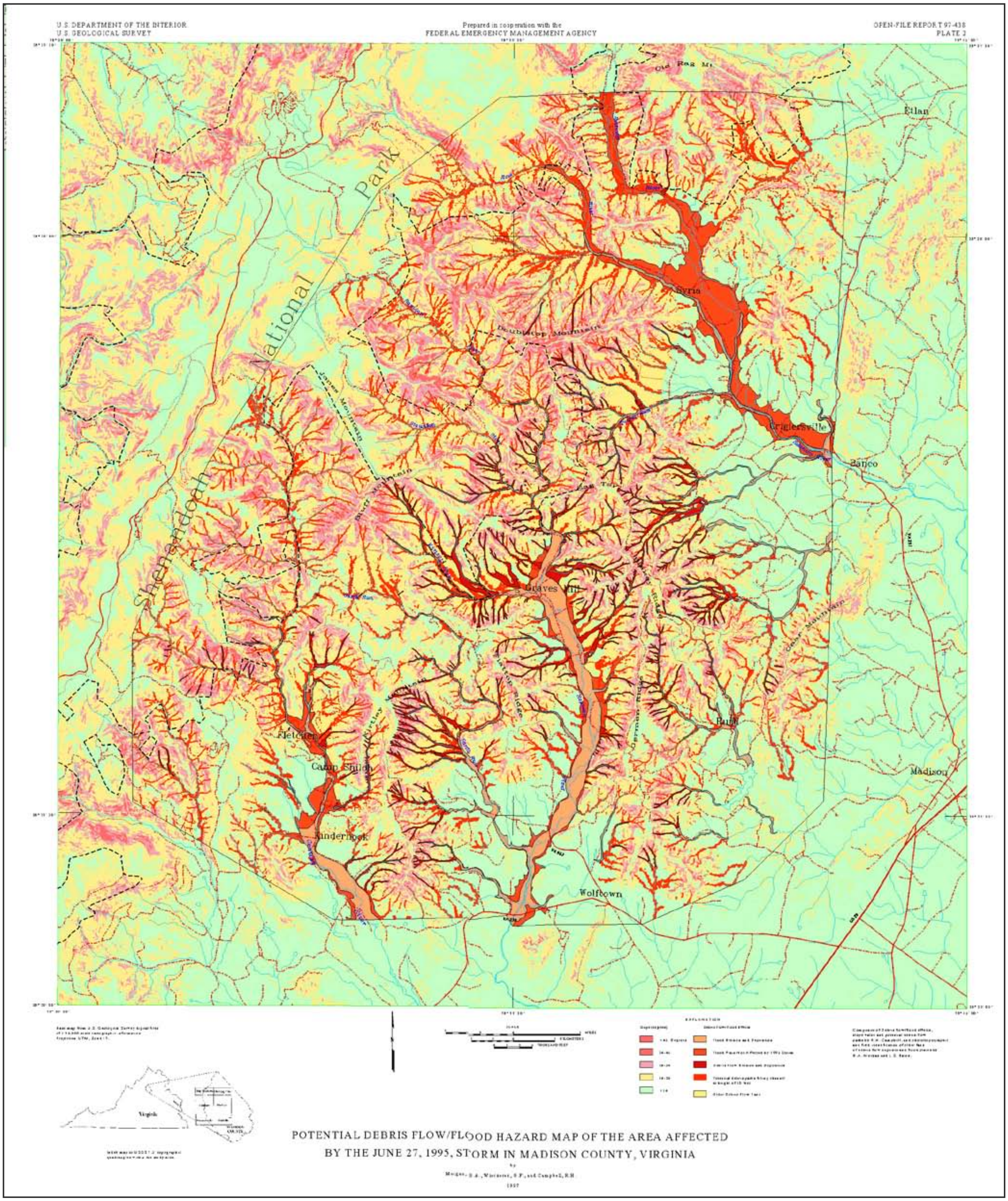
Because sinkholes have occurred in the region in the past, it can be expected that they will occur again in the future, however, vulnerability is considered to be negligible because these events are very random and do not effect a large area.

LANDSLIDES

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 will 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.

Figure 6.7
USGS Landslide Study for Madison County



DAM / LEVEE FAILURE

Figure 6.8 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.

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.

FUTURE VULNERABILITY

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*. Future Plan updates will 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.

UNIQUE RISKS FOR LOCAL JURISDICTIONS

Four jurisdictions – the Town of Orange (2005), Rappahannock County (2005), Culpeper County (2012) and the Town of Culpeper (2012) identified unique risks as part of the Hazard Mitigation planning process. These risks are summarized below.

Jurisdiction: Town of Orange
Unique Hazards:

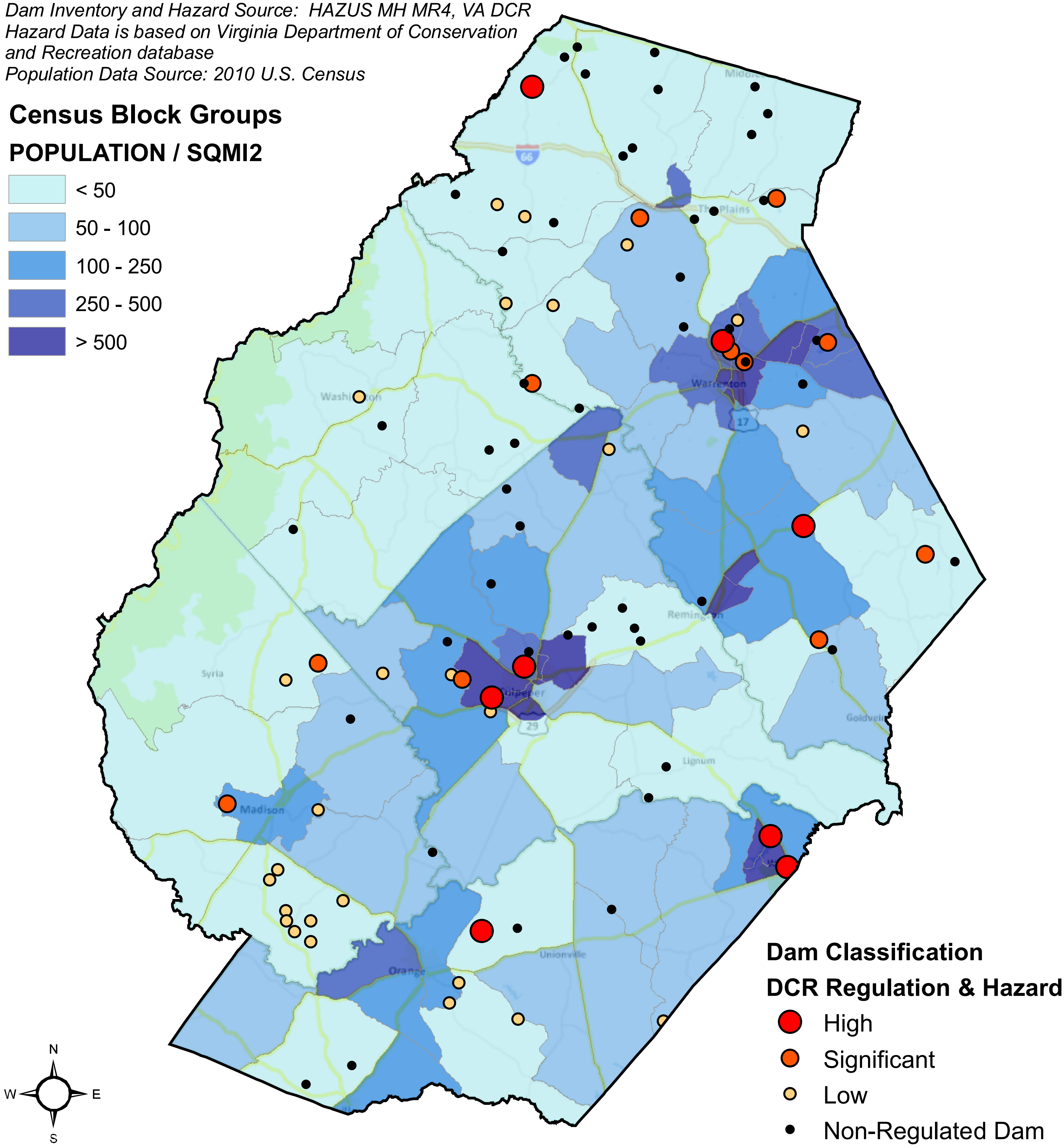
- Railroad goes right through the middle of East Main Street. Various chemicals and hazardous materials are transported by train frequently.
- Natural Gas Plant in Unionville (piped throughout county)
- Proximity to North Anna Nuclear Power Plant
- Interstate corridor (Interstates 64 and 95) increases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

Dam Hazard & Vulnerability

Figure 6.8

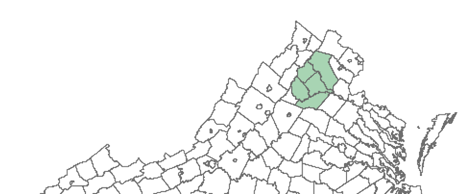
Rappahannock-Rapidan Regional Hazard Mitigation Plan
Dam Inventory and Hazard Source: HAZUS MH MR4, VA DCR
Hazard Data is based on Virginia Department of Conservation and Recreation database
Population Data Source: 2010 U.S. Census



Rappahannock-Rapidan
REGIONAL COMMISSION

Miles
0 5 10 15 20

Map created for Rappahannock-Rapidan Regional Hazard Mitigation Plan Update and is intended for general planning purposes only. Data is from various sources and may vary in accuracy and completeness.
Date: 6/2/2011 File: Dam_Vulnerability.mxd



Jurisdiction: Rappahannock County
Unique Hazard: The presence of Shenandoah National Park means that wildfire is both a heightened risk as well as an unmanageable one.
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

Officials from Madison and Rappahannock Counties also wished to note an increase of their wildfire hazard risk ranking from "Low" to "High."

Jurisdiction: Culpeper County
Unique Hazards:

- 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 utilites

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

Hazard	Estimated Annualized Losses
Drought	$2,046,333
Flood	$1,884,727*
Tornades	$500,600
Severe Thunderstorms (includes Lightning & Hail)	$351,800
Earthquakes	$240,000
Winter Storms	$167,864
Hurricanes	$139,000
Wildfire	$42,522**
Sinkholes	Unknown
Landslides	Unknown
Erosion	Unknown
Dam/Levee Failure	Unknown

*Table includes flood hazard estimate generated by non-HAZUS GIS analysis (see Section 6, page 13)

**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**
Hurricanes and Tropical Storms	Possible (1)	Large (3)	Critical (3)	**7**
Winter Storms	Likely (2)	Large (3)	Limited (2)	**7**
Severe Thunderstorms and Tornadoes	Highly Likely (3)	Small (1)	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/Levee Failure	Possible (1)	Moderate (2)	Limited (2)	**5**
Landslides	Likely (2)	Small (1)	Minor (1)	**4**
Erosion	Likely (2)	Small (1)	Minor (1)	**4**
Sinkholes	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 hurricane and tropical storm, and the winter storm hazard. The three moderate-risk hazards identified are the drought, severe thunderstorm and tornadoes and wildfire hazards. All other hazards are classified as low risk.[10]

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

HIGH RISK HAZARDS	Flood Hurricanes and Tropical Storms Winter Storms
MODERATE RISK HAZARDS	Drought Severe Thunderstorms and Tornadoes Wildfire
LOW RISK HAZARDS	Earthquakes Sinkholes, Landslides Dam/Levee Failure Erosion

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).

[10] Human caused hazards have been similarly ranked in Appendix E.

CAPABILITY ASSESSMENT

PURPOSE

The Rappahannock-Rapidan region's capability assessment was conducted to determine the ability of participating localities to develop and implement a comprehensive hazard mitigation strategy 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 2012 plan update, the Hazard Mitigation Committee and RRRC staff reviewed and revised the inventory of local plans, regulations and ordinances developed in the 2005 Hazard Mitigation Plan (table 7.1). A description of the 2005 *Capability Assessment Survey* can be found 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.*

Participating jurisdictions were also given the opportunity to provide additional information for the capability assessment through four worksheets developed specifically for the 2012 plan update. These worksheets requested information on each locality's regulatory capabilities, administrative/technical resources, fiscal resources and additional local capabilities. Copies of the worksheets can be found in Appendix C: Supporting Documentation.

FINDINGS

Findings are summarized as follows. Information is presented based on the five categories of local capability:

- Planning and Regulatory Capability
- Emergency Management
- General Planning
- Floodplain Management
- Administrative/Technical Capability
- Fiscal Capability

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 will help determine opportunities to address existing gaps, weaknesses or conflicts among existing strategies and will facilitate integrating this plan with existing planning mechanisms.

Table 7-1 provides a summary of the relevant tools already adopted or being developed by the Rappahannock-Rapidan region's participating local governments.

Table 7-1
Relevant Plans, Ordinances, and Programs

Jurisdiction	National Flood Insurance Program	NFIP Community Rating System	Hazard Mitigation Plan	Disaster Recovery Plan	Comprehensive Land Use 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 – xx	x		x	Δ	x			x	x	x	x	x	x	x	x	x	x	x	x					
Town of Culpeper - xx	x		x	Δ	x	x	x	●	●	●		●	x	x	x	x	x	x	●	Δ	x			
Fauquier County - xx	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
Town of Warrenton – xx	x		x		x	x	x	●			x		x	x	x	x	x		x	x	x			
Town of Remington – xx	x		x	x	x	x	Δ	●		●	●	●	●			X	X	X	●	●				x
Madison County - xx	x		x		x	x	x	x			x	x		x	x	x	x		x	x				
Town of Madison - xx			x		x	●	●	●			●	●			x	x	x		●	●				
Orange County - xx	x		x	Δ	x	x	Δ	x	x	x	x	x	x	x	x	x	x	x	x	x				
Town of Orange - xx	x		x		x		Δ	●		●		x		x		x	x		●	●				
Rappahannock County	x		x	x	x	x		x		x	x	x			x	x	x	x	x		x			x

X – in place and being implemented, or being developed
Δ - Use State Plan
● - Use County Plan/Ordinance

Emergency Management

Hazard mitigation is recognized as one of the four primary aspects of emergency management. Others are preparedness, response and recovery. All are interconnected and interdependent, as indicated by **Figure 7-1.** 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.

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. Since then it 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 should 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 jurisdictions.

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 two do not have a plan.

General Planning

The development and implementation of effective hazard mitigation plans and activities routinely involves agencies, organizations and individuals beyond the emergency management profession. Additional stakeholders may include local planners, public works officials, economic development specialists and others. Because concurrent local planning efforts often address hazard mitigation goals, the *Capability Assessment Survey* included questions regarding each jurisdiction's general planning capabilities and the degree to which hazard mitigation is integrated into other ongoing planning efforts.

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 in the Rappahannock-Rapidan region maintain Capital Improvements Plans. Of the participating towns, the Town of Culpeper and Town of Orange 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.[1] 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 have historic preservation plans and/or ordinances in place. Three of the five participating towns also have such plans in place.

[1] See Protecting the Past from Natural Disasters. 1989. Nelson, Carl. National Trust for Historic Preservation: Washington D.C.

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.[2]

- All participating jurisdictions have a subdivision ordinance.

Building Codes, Permitting and Inspections: Regulate construction standards by reviewing plans, issuing permits and inspecting for compliance. Decisions regarding the adoption of building codes that account for hazard risk, the permitting process required both before and after a disaster, and the enforcement of inspection protocols all affect the level of hazard risk faced by a community.

- All five counties have a building code, one town has its own building code, and four towns use their respective county's code.

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).[3] 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.

[2] For additional information regarding the use of subdivision regulations in reducing flood hazard risk, see Subdivision Design in Flood Hazard Areas. 1997. Morris, Marya. Planning Advisory Service Report Number 473. American Planning Association: Washington D.C.

[3] Participation in BCEGS is voluntary and may be declined by local governments if they do not wish to have their local building codes evaluated.

Table 7.2
BCEGS Ratings in the Region

Jurisdiction	BCEGS Residential Rating	BCEGS Commercial Rating	Year Last Rated
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
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.**

Table 7-3
CRS Premium Discounts, By Class

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

Source: *FEMA*

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.

- 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.

- Two counties and one town have local stormwater management regulations in place, with one other county and two towns governed by state-level stormwater management regulations.

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. It should be noted that, in the region, only Fauquier County has a dedicated floodplain manager, though the other counties have staff with floodplain management capabilities. In general, the larger towns (Culpeper, Orange, Warrenton) are able to provide administrative and technical oversight via their own staff, but the smaller towns (Madison, Remington, The Plains, Washington) rely heavily on their respective county staffs for technical assistance.

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.

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 offers grant-writing and administrative assistance to its member jurisdictions and also facilitates inter-jurisdictional grant efforts, as applicable.

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. Given the economic climate during the past 5 to 7 years, local matching funds are stretched even further. The smaller towns in the region have limited budgets and limited staff and would be unlikely to meet mitigation grant matching requirements.

Mitigation Strategy

Introduction

A mitigation strategy provides participating localities 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 R-RRC 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 impacts, both physical and monetary, 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 capabilities and plan for the potential impacts of a potential 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 Appendix A, *Locally-specific Mitigation Actions*. **Figure 8.1** represents the general format in which each mitigation action was recorded. Each action was designed to achieve the goals identified in the R-RRC *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. Prioritizing mitigation actions for each jurisdiction was based on the following five (5) factors: (1) effect on overall risk to life and property; (2); ease of implementation; (3) political and community support; (4) a general economic cost/benefit review[1]; and (5) funding availability.

As mentioned above, each action was prioritized by the jurisdiction that identified the action. An overall ranking of High, Moderate or Low was given to each action based on analysis of the action in terms of the five factors listed above.

Mitigation Techniques in the R-RRC 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 R-RRC planning area included an array of actions, not just those addressing high and moderate risk hazards.

Figure 8.2
Mitigation Matrix

MITIGATION TECHNIQUE	HIGH RISK HAZARDS				MODERATE RISK HAZARDS		
	Flood	*Hurricanes and Tropical Storms*	*Severe Thunderstorm and Tornadoes*	*Winter Storms*	*Drought*	*Earthquake*	*Wildfire*
Prevention	X	X	X	X	X	X	X

[1] Only a general economic cost/benefit review was considered through the process of selecting and prioritizing mitigation actions for each jurisdiction. Mitigation actions with "high" priority were determined to be the most cost effective and most compatible with each jurisdiction's unique needs. A more detailed cost/benefit analysis will be applied to particular projects prior to the application for or obligation of funding, as appropriate.

Property Protection	X						
Natural Resource Protection	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 in Appendix A 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, however, this is an element of the Plan that should be improved over time as new mitigation techniques for different hazards are identified. Over time, each jurisdiction should identify at least one mitigation action to address each of the hazards that impact the region.

As part of the 2012 revision to the Rappahannock-Rapidan Regional Hazard Mitigation Plan, participating jurisdictions updated the progress on the proposed mitigation strategies from the 2005 plan. A full listing of the progress to date on the 2005 strategies can be found in Appendix A: Local Mitigation Strategies. In general, most localities have made progress on the 2005 mitigation strategies, through ordinance reviews, floodplain reviews and management and GIS implementation and development. Some of the efforts to date include:

- 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.
- 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 2005 plan and the 2012 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

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 2012 Hazard Mitigation Plan Update.

ADOPTION

The 2012 revision of the Rappahannock-Rapidan Hazard Mitigation Plan is expected to be adopted by participating jurisdictions in early Fall 2012. All resolutions for adoption of the plan will be included in Appendix D of the Plan. Public comment was solicited during the drafting of the plan revision and prior to adoption by each participating jurisdiction. Local emergency management officials, planners and RRRC staff were available to discuss the project at all public meetings and hearings.

IMPLEMENTATION

Each jurisdiction participating in this Plan is responsible for implementing specific mitigation actions as prescribed in the *Mitigation Strategy* section (Section 8). 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 2005 local mitigation strategies is included as part of Appendix A: Local Mitigation Strategies. In general, most localities have made progress on the 2005 mitigation strategies, through ordinance reviews, floodplain reviews and management and GIS implementation and development. Some of the efforts to date include:

- 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.
- 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 2005 plan and the 2012 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

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 identified new strategies as part of the 2012 plan update process, all of which are included in Appendix A.

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.

For further integration into existing planning documents, each participating jurisdiction should 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 2005 plan adoption and 2012 plan revision, 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 R-RRC 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 R-RRC through the Regional Hazard Mitigation Planning Committee at which time all local amendments should be incorporated into the Regional Plan. The Plan will also be submitted to the State Hazard Mitigation Office for formal review. Each jurisdiction is encouraged to make yearly reviews and minor changes without approval from the R-RRC (see Local Plan Amendment Process below).

Plan Monitoring

R-RRC will be responsible for the continued coordination of the monitoring of this plan. The Emergency Management Coordinator from each county will make yearly updates to R-RRC on the progress of the implementation of their mitigation actions. The yearly reports should coincide with the anniversary of the approval date of this plan, or other annual benchmark date as identified by the Hazard Mitigation Committee members.

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 wish to not participate in future updates of the Plan, they must notify R-RRC staff in writing.

Disaster Declarations

Following a disaster declaration, the Plan will be reviewed by each effected 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 2012 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 R-RRC 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 along with recommended strategies to overcome them.

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 shall make an annual report to R-RRC documenting any changes made to the Mitigation Actions.

CONTINUED PUBLIC INVOLVEMENT

Public input was an integral part of the completion of both the original R-RRC Regional All-Hazards Mitigation Plan and the 2012 update. 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, as well as the 2012 plan update meeting documents and dates and draft plan 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 in the local paper, on public bulletin boards and/or in city and county office buildings;
- 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
- Keeping copies of the Plan in all public libraries within the county.

The Virginia Department of Emergency Management or members of the R-RRC Planning Team may also provide suggestions.