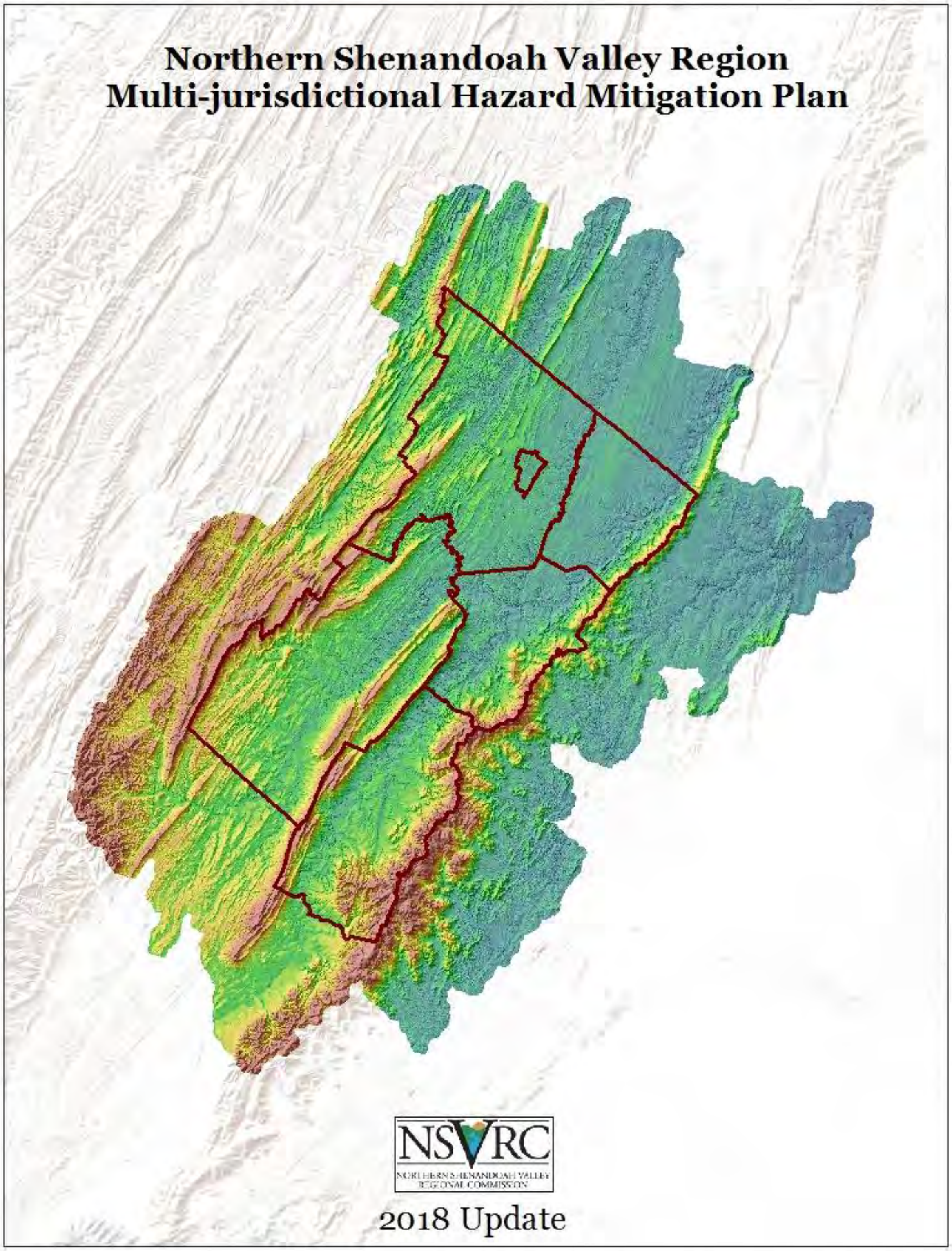

Northern Shenandoah Valley Region
Multi-jurisdictional Hazard Mitigation Plan
NSVRC
NORTHERN SHENANDOAH VALLEY REGIONAL COMMISSION
2018 Update

Chapter 1: Introduction

Mitigation Planning

Mitigation is a sustainable action taken to prevent or help ease the severity of devastation due to a catastrophic event. Hazard Mitigation Plans specifically aim to help communities better prepare themselves for impending natural disasters. An effective plan lessens or prevents the impacts of disaster, by readying the community with a set of preemptive or reactive procedures, should such an event threaten or occur.

State, tribal and local leaders use mitigation planning for developing a long-term comprehensive strategy, for community disaster readiness. Hazard Mitigation Plans serve as a reference for local officials who make decisions regarding regulations and ordinances, granting permits, and funding capital improvements or other community initiatives. Additionally, these local plans will serve as the basis for states to prioritize future grant funding as it becomes available. These plans are formulated through a systematic process centered on the participation of citizens, businesses, public officials, and other community stakeholders.

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 update deals primarily with natural hazards, human-caused hazards were identified as an area for future mitigation planning efforts. A central theme of hazard mitigation is that pre-disaster planning will significantly reduce the demand for post-disaster assistance by lessening the need for emergency response, repair, recovery and reconstruction and encourage locality resilience to disasters.

The primary objective of the planning process is to identify strategies to reduce the impact of hazards. The strategies identify responsibility for each mitigation action, prioritization, and other mechanisms to encourage its implementation. Plan maintenance procedures (located in Chapter 7 of this Plan) are established to monitor progress, including the regular 5 year evaluation and enhancement of the Plan. The maintenance procedures ensure that the Plan remains a flexible tool to assist localities in the Northern Shenandoah Valley Region. When utilized, the Hazard Mitigation Plan provides an array of benefits to the community at hand. Such benefits include: saving lives and property; saving money; enhancing response time for recovery following disasters; reducing future vulnerability through effective planning; improving eligibility and facilitating the receipt of pre-disaster and post-disaster grant funding to localities; and demonstrating a firm commitment to community health and safety by reducing and mitigating adverse effects associated with natural disasters.

DMA2k Planning Requirements

This 2018 update to the Regional Hazard Mitigation Plan (plan update) is intended to satisfy state mitigation planning requirements of the Disaster Mitigation Act of 2000 (DMA2K) at 44 CFR §201.4 and Public Law 106-390, signed into law October 10, 2000 which amends the 1988 Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act). The plan update is for the Northern Shenandoah Valley region, including the City of Winchester, the five Counties of Clarke, Frederick, Page, Shenandoah, and Warren and the 14 Towns therein. Under the Act DMA2K, every locality recognized by the State Code that adopts a local or regional hazard mitigation plan every five years, remains eligible for the funding opportunities from hazards offered through the U.S. Federal Emergency Management Agency (FEMA), as part of the Department of Homeland Security (DHS). Therefore, by adopting this Plan update, the localities included in this Plan update will remain eligible for Hazard Mitigation Grant Program (HMGP) funds and the Hazard Mitigation Assistance (HMA) programs which include Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), Repetitive Flood Claims (RFC), and Severe Repetitive Loss (SRL) grant programs.

The Virginia Department of Emergency Management's Emergency Operations Plan Standard Hazard Mitigation Plan, Support Annex 3 (Volume II) requires each of Virginia's cities, counties, and towns to:

> *"...develop or take an active role in the development of a hazard mitigation plan for their respective areas. The PDCs are not required to develop a separate hazard mitigation plan for their regions, as they do not have the enforcement authority of the cities, counties, and incorporated towns. However, as described in Section 6.3.5(d), it was the intent of the Commonwealth of Virginia to combine as many of the mitigation plans as possible into regional, multi-jurisdictional plans using the PDCs as the planning agency for these efforts."*

Preparation of this 2018 Plan update was carried out by the local Northern Shenandoah Valley Regional Commission (VA Planning District Commission 7) under funds secured from the VDEM Pre-Disaster Mitigation Grant Program (PDM), which is further outlined in chapter 2 of this Plan. Regional Hazard Mitigation Plans are more cost effective than local plans, because mitigation staffing at the state level can be limited. In order to remain in sync with neighboring localities and their mitigation planning techniques, it is suggested that they *"remain regionalized to the extent possible." – Virginia Department of Emergency management (VDEM).* The FEMA provided regulation checklist found in the "Local Mitigation Plan Review Tool," outlines the federal requirements that need to be addressed in this plan. The regulation checklist, which lists the specific regulations and their location in this plan, can be found in the appendix of this plan.

Organization of the Plan

Chapter 2: Planning Process

Regulation §201.6(c)(l) – Documentation of planning process, including how it was prepared, and who was involved, in the process.

The plan update process was organized and executed by the Northern Shenandoah Valley Regional Commission (NSVRC), using the FEMA developed "*Local Mitigation Planning Handbook,*" as the principal guiding document. Guidance worksheets, found in handbook, were used to structure the update timeline, meeting agendas, and overall update work plan.

The Northern Shenandoah Valley Regional Commission was formed by its local governments in 1968, under the authority of the Virginia Area Development Act. The Commission is made up of eighteen elected officials and twelve citizens appointed to the Commission by the eleven member local governments. The Commission provides a variety of technical services to its member local governments including: planning, mapping, grant application assistance, and network meetings. Programs which serve citizens, the private and non-profit sectors include:

- Consultant selection RFP/RFQ's
- General Planning:
  - land use, transportation (motorized & non-motorized),environmental, comprehensive, housing & planning community services
- Financial administration for government programs
- GIS & Mapping
- Grant application preparation
- Highway project scoping field views (with VDOT)
- Data collection, analysis & reporting
- Marketing assistance
- Public involvement (in person & on-line)
- Professional development opportunities
- Project administration/management
- Regional re-certification training services
- Rideshare/commuter assistance
- Road safety audits
- State mandates:
  - recycling rate report, regional water supply plan
- Technical assistance for comprehensive plan updates
- Website development

Local adoption of this Plan update and FEMA approval, are required for localities to remain eligible for FEMA funding through Hazard Mitigation Assistance (HMA) programs. The HMA programs provide funding opportunities to reduce the risk to individuals and property from natural hazards. Local governments are encouraged to apply for these HMA programs in both pre and post-disaster timeframes. This Plan provides a prioritization of strategies for localities to consider for future funding opportunities, which should ultimately lessen adverse impacts from natural (and human-induced) disasters. The HMA programs facilitate the reduction or elimination of potential losses through hazard mitigation planning and project grant funding. Each HMA program, authorized by separate legislative action, has a different scope but all have a common goal of reducing the risk of loss of life and property due to natural hazards.

Table 2.1 - Potential Future Funding of Strategies in this Plan
Hazard Mitigation Grant Program (HMGP)
Pre-Disaster Mitigation Program (PDM)
Flood Mitigation Assistance Program (FMA)
Repetitive Flood Claims Program (RFC)
Severe Repetitive Loss Program (SRL)

Table 2.1 – Potential Future Funding of Strategies in this Plan

If a grant is awarded by FEMA (often administered through VDEM), then the locality or NSVRC (on behalf of a locality) is a "sub-grantee" and is responsible for managing the sub-grant and complying with program requirements and other applicable Federal, State, and local regulations. The steering committee requested these funding opportunities be clearly presented in this Plan as well as on the NSVRC website. To meet these requests, the following is a list of funding programs.

- **Hazard Mitigation Grant Program**
  - Localities with an adopted hazard mitigation plan (approved by FEMA) are eligible to qualify for post-disaster mitigation funds.
- **Pre-Disaster Mitigation Grant Program**
  - Localities with an adopted hazard mitigation plan (approved by FEMA) are eligible to qualify for pre-disaster mitigation funds, local jurisdictions must adopt a mitigation plan that is approved by FEMA.
- **Flood Mitigation Assistance Program**
  - Localities with an adopted, FEMA-approved mitigation plan are eligible to qualify for funds to implement projects including acquisition or elevation of flood-prone structures. The plan must be prepared following the process outlined in the National Flood Insurance Program's (NFIP) Community Rating System (CRS).
- **Community Development Block Grants**
  - The Housing and Urban Development's (HUD) CDBG program works to ensure decent affordable housing, to provide services to the most vulnerable in our communities, and to create jobs through the expansion and retention of businesses. Community Development Block Grants are important tools for helping local governments tackle serious challenges facing their communities.
- **Capital Improvement Plans**
  - Capital Improvement Plans (CIP) – as established by the county/city - determine annual budgets and funding sources for maintenance and development needs, as well as provide important analysis regarding planning efforts with city departments. The CIP is also supported by general obligation and revenue bonds, tax increment financing,

federal and state grants, certificates of participation, local improvement districts, metropolitan districts and private grants.

- **Overall Funding descriptions**
    - The HMA Unified Guidance can be found on FEMA's website at: http://www.fema.gov, and at NSVRC website http://www.NSVregion.org

Hazards were identified and ranked according to discussions during meetings and in an on-line survey issued to localities. The on-line survey was available during throughout the update planning process. Outcomes of the hazard evaluations included acknowledgement of the importance of winter ice storms as well as flooding as key natural hazards. Flooding was ranked as the number one natural hazard in terms of likelihood of highest damage. The 2018 hazards featured in this plan rank the same as those featured in the 2012 plan, though some priorities may have shifted. All hazard maps featured in this Plan have been updated with the best and most recent data available.

Planning Area

The Northern Shenandoah Valley Regional Commission's planning area includes the Northern Virginia counties of Clarke, Frederick, Page, Shenandoah, Warren, their incorporated towns, as well as the City of Winchester.

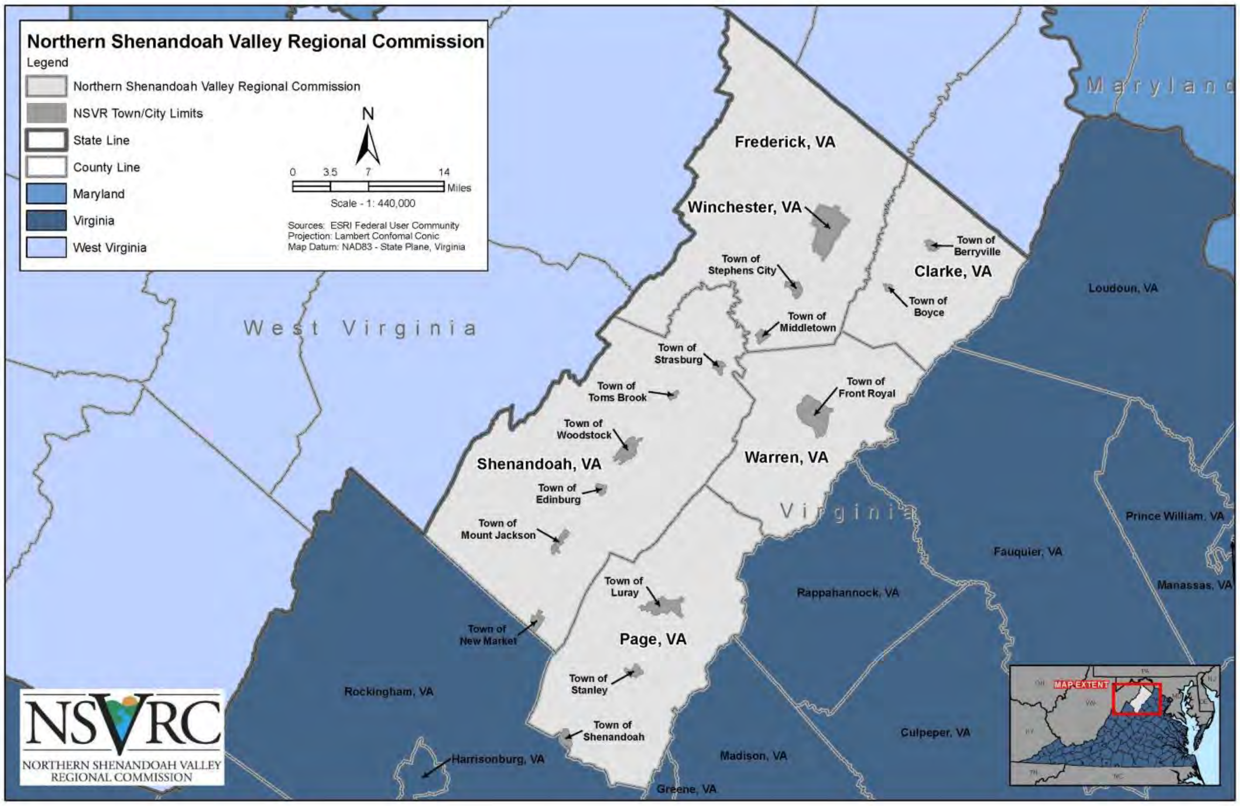


Figure 2.1 – Northern Shenandoah Valley Regional Commission – Source: ESRI, NSVRC

This plan is a 5 year update to the NSV Region's previously adopted 2012 Multi-Jurisdictional Hazard Mitigation Plan. The 2012 plan was designed for the same planning area as stated above and served as the primary basis for this plan update.

Funds obligated through the Pre-Disaster Mitigation Grant Program (PDM) were awarded to the NSVRC in April of 2016. The NSVRC commenced update process in November of 2016, once the grant award package was authorized.

Steering Committee and Larger Planning Group

An update steering committee was comprised of local officials who worked closely with the NSVRC throughout the planning process. The steering committee featured a representative from each county within the NSVRC planning area, with each member acting as delegate for both the county and its encompassed towns. These officials provided a voice for their county citizens and stakeholders, while relaying back any pertinent information throughout the plan update process. The committee was also encouraged to be continually proactive in gaining participation from individuals from their jurisdictions and/or organizations.

A Memorandum of Agreement (MOA) was distributed and signed by these participating steering committee members or an official from their locality, in order to establish commitment to the collaborative update process. The MOA authorized the planning member to represent the county throughout the NSVRC 2018 Hazard Mitigation Plan Update process. By signing the MOA, it was understood that the representative listed would be engaged in:

- Developing the Work Program and Schedule with the Planning Team
- Organizing and attend regular meetings of the Planning Team (Monthly - every 2nd Wednesday)
- Assisting the Planning Team with developing and conducting an outreach strategy to involve other planning team members, stakeholders, and the public, as appropriate to represent their Jurisdiction
- Identifying community resources available to support the planning effort, including meeting spaces, facilitators, and media outlets
- Providing data and feedback (as needed) to develop the risk assessment and mitigation strategy, including a specific mitigation action plan for their jurisdiction
- Submitting the draft plan to their jurisdiction for review
- Working with the Planning Team to incorporate all their Jurisdiction's comments into the draft plan
- Submitting the draft plan to their respective governing body for consideration and adoption
- After adoption: coordinating a process to monitor, evaluating, and working toward plan implementation

MOAs found in Appendix A designated the following jurisdictional representatives, who made up the 2018 Hazard Mitigation Steering Committee (table 2.2):

Table 2.2 - Northern Shenandoah Valley Region Multi-Jurisdictional Hazard Mitigation Plan Update - Steering Committee Members	
Locality	**Member, Title**
Clarke County	**Brian Lichty, Director of Fire and EMS**
Frederick County	**Chester Lauck, Deputy EM Coordinator**
Page County	**Woody Brown, Emergency Manager**
Shenandoah County	**Jill Jefferson, Planner**
Warren County	**Rick Farrall, Deputy Emergency Manager** **Matt Wendling, Count Floodplain Manager**
City of Winchester	**Lynn Miller, EM Coordinator**

Table 2.2 - Northern Shenandoah Valley Region Multi-Jurisdictional Hazard Mitigation Plan Update - Steering Committee Members

The following project tasks timeline was developed and agreed upon by the 2018 Hazard Mitigation Plan Update Steering Committee:

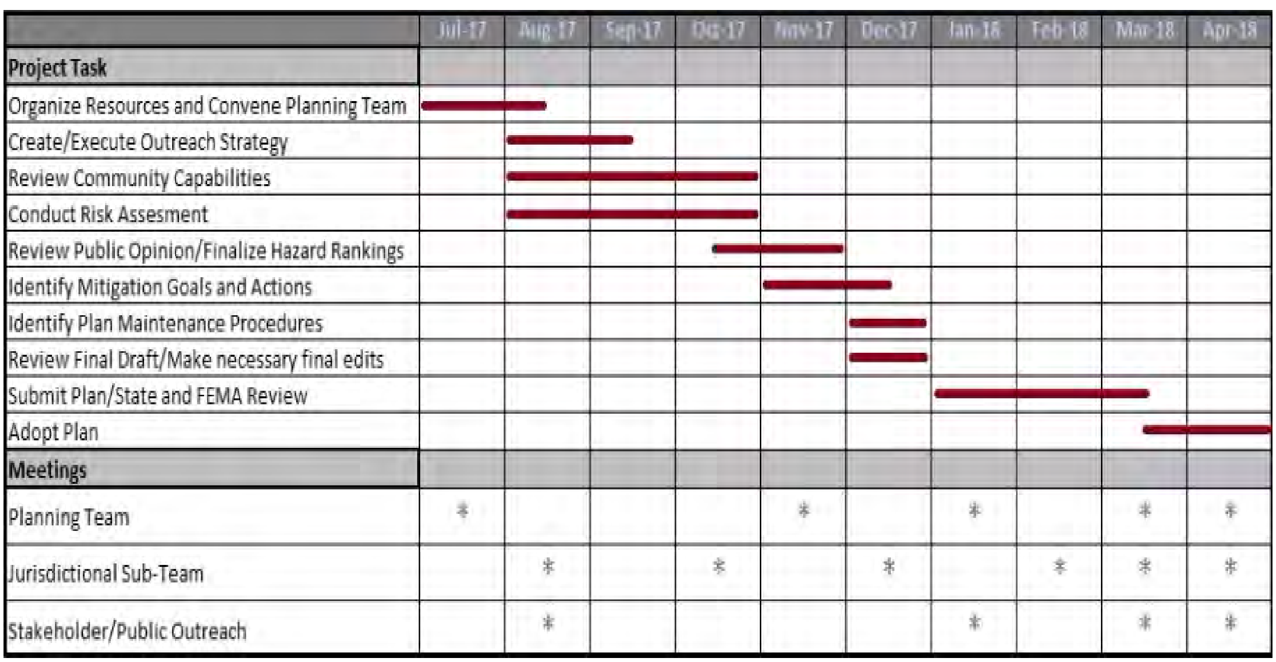


Table 2.3 - Hazard Mitigation Plan Update Tasks and Timeline

The plan update process was organized based on tasks as presented in the FEMA *"Local Mitigation Planning Handbook,"* to ensure that the team met the standards expected for an efficient hazard mitigation plan.

The following were provided opportunities to review and comment on the Plan update were invited as participants to the meetings, as well as given the chance to provide input and comment to affect the Plan's content:

- Local and regional agencies involved in hazard mitigation activities (Catherine Hughes, Amy Howard and Mark Stone of VDEM, as well as all regional emergency response coordinators)
- Agencies that have the authority to regulate development (each participating locality's planning staff and or designee along with elected officials)
- Neighboring communities and interested citizens

Invitations to participate in the hazard mitigation planning process were distributed amongst a list of officials from various local agencies and governmental departments. It was also encouraged at every meeting that attendees be proactive in gaining the interest of their community, citizens and officials alike. The following were notified of the planning process and invited to participate:

- Chief Administrative Officers (Town Managers, County Administrators, City Manager)
- Regional emergency managers
- Regional public works employees
- The Northern Valley Emergency Planning Team (NVEPT)
- Shenandoah National Park
- Steering committee members on the 2012 Hazard Mitigation Plan
- Various other organizations in the NSV region

Participating jurisdictions were communicated to electronically, with updates regarding opportunities to participate in mitigation strategy updates and reviewing the draft plan. Details regarding the monthly planning meetings were provided in the NSVRC monthly media releases announcing each meeting location, time, and purpose to encourage involvement and participation from the community and interested citizens. Press releases and public announcements are also included in Appendix C of this Plan.

The larger planning group consisted of local officials that were available to provide additional support to the steering committee. Members of this group were able to provide reference in mitigation planning as it relates to their specific department or jurisdiction, displayed here in table 2.4.

Table 2.4 - Northern Shenandoah Valley Region Multi-Jurisdictional Hazard Mitigation Plan Update Larger Planning Group

Locality /Organization	Member, Title
DCR	Charley Banks, Flood Plain Manager
Town of New Market	Alex Berryman, Town Planner/Zoning Administrator
Page County	Kelly Butler, Senior Program Support Technician
Town of Luray	Chief C.S. Bow Cook, Page County Sherriff's Office
NSVRC	Brandon Davis, Executive Director
Town of Berryville	Keith Dalton, Town Manager
DCR	Gina Dicicco, Flood Plain Manager
Shenandoah County	David Ferguson, Fire Marshall
Lord Fairfax Health District	Justin Ferrell, Local Health Emergency Coordinator
Town of Woodstock	Lemuel Hancock, Urban Designer & Neighborhood Planner
VDEM	Amy Howard, Mitigation Grants Administrator
Town of Luray	Charlie Hoke, Town Manager
VDEM	Alexa Hussar, Disaster Response and Recovery Officer
VDEM	Catherine Hughes, All-Hazards Planner
Town of Toms Brook	Stephanie Langton, Planner & Zoning Administrator
Page County	Stephanie Lillard, Director of Community and Economic Planning
Warren County	Taryn Logan, Planning Director
NSVRC	John Madera, Principal Planner
Town of Stephens City	Mike Majher, Town Manager & Planner
Town of Strasburg	Wyatt Pearson, Town Manager
Town of Stanley	Terry Pettit, Town Manager

Table 2.4 – Northern Shenandoah Valley Region Multi-Jurisdictional Hazard Mitigation Plan Update Larger Planning Group *(continued)*	
Clarke County	**Brandon Stidham, Planning Director**
VDEM	**Mark Stone, Region 2 Chief Regional Coordinator**
Town of Boyce	**Dennis Utterback, Planning Commission Chairman**
Shenandoah County	**Shannon Walter, Service Assistant**
Town of Front Royal	**Joseph Waltz, Town Manager**
Warren County	**Matt Wendling, Planner / County Floodplain Manager**

Table 2.4 – Hazard Mitigation Plan Update Larger Planning Group

Note The Larger Planning Group was apprised of meetings; however, the majority of meetings was staffed by the Hazard Mitigation Steering Committee*

NSVRC Commission Board

Comprised of local elected officials and citizens appointed to the Commission by local governments, the NSVRC Commission Board plays a vital role in promoting coordination and cooperation between its jurisdictions. The board was apprised of all meetings and the plan update draft was presented at the January board meeting. The commission board was invited to comment and provide any feedback they felt was helpful or necessary. Table 2.5 lists the various commission board members from their given jurisdiction.

Table 2.5 - Northern Shenandoah Valley Regional Commission Board *(E) denotes elected officials*
Clarke County
Bev McKay (E)
Brandon Stidham
Frederick County
Blaine Dunn (E)
Shannon Trout (E)
Eric Lawrence
Kris Tierney
Page County
Nora Belle Comer
Shenandoah County
Conrad Helsley (E)
Dennis Morris (E)
Warren County
Daniel Murray (E)
Tom Sayre (E)
John Vance
Winchester
Mayor David Smith (E)
Evan Clark (E)
Tim Youmans
Town of Berryville
Mayor Pat Dickinson (E)
Town of Front Royal
Bill Sealock (E)
Jeremy Camp
Town of Middletown
Carolyn Aliff (E)
Town of Strasburg
Jocelyn Vena (E)
Town of Stephens City
Linden Fravel (E)
Town of Woodstock
Jackie Lambert (E)

Table 2.5 – Northern Shenandoah Valley Regional Commission Board Members

Public Participation and Citizen Input

The public outreach efforts were designed to solicit community input prior to submittal to the Virginia Department of Emergency Management and again, prior to adoption by a participating jurisdiction. In addition, the draft Plan 2018 update was available for review with drafts sent to surrounding localities and relative agencies.

The public was invited to participate in the Plan update. Media releases were issued to describe the status of the Plan update and inform the public of upcoming opportunities to participate in the planning process. A public outreach event was scheduled to take place at the Northern Valley Emergency Planning Team's November 2017 meeting. This meeting was announced via press release and through radio advertisement. It was open to the public and media was invited to attend. Press release and other public advertisements can be found in Appendix C of this Plan.

An electronic copy of the 2012 Plan and the 2018 *Draft* Hazard Mitigation Plan, were made available for public review and comment on the NSVRC website (www.NSVregion.org). More information regarding the NSVRC website's involvement in the Hazard Mitigation Plan Update can be found in this chapter of the plan. Announcements were made on the NSVRC website encouraged the following to review and provide feedback on the draft plan:

- neighboring communities
- agencies involved in hazard mitigation activities
- agencies having authority to regulate development
- local and regional businesses
- local academia
- other private and non-profit interests

NSVRC staff relayed information collected from the site to the Hazard Mitigation Steering Committee, and will continue to do so as part of the plan maintenance (outlined in chapter 7 of this Plan). In addition, the NSVRC website will serve as a an online portal for posting Hazard Mitigation related local plans/ reports/studies, as they are updated or come available.

NSVRC Hazard Mitigation Online Portal

An online Hazard Mitigation portal was developed by NSVRC staff, which features the update calendar, meeting agendas, meeting minutes, a document center with all FEMA guidance worksheets used throughout the planning process, tables and maps featured in the plan, as well as other helpful information regarding Northern Shenandoah Valley Region Hazard Mitigation Planning. Most of the maps featured on the site have interactive functionality, which allows the user to gain a better understanding of just how vulnerable their communities or properties are to a specific natural hazard.

These interactive maps provided an opportunity for steering committee members to gain a better analysis of the various hazards affecting the region. They can also be very useful reference tools for officials. It is outlined in the plan maintenance section, that NSVRC staff will update these maps at least bi-annually and continue to provide public access.

The NSVRC Hazard Mitigation Online Portal can be found at http://www.nsvregion.org/hazard-mitigation. This site was available to the public throughout the entire Plan Update process, allowing anyone with internet access to view the features mentioned above. It was an important tool in providing the transparency and keeping the public informed about the update process. The NSVRC Hazard Mitigation Online Portal will remain open to the public 24 hours a day and will be continually updated, as specified in the maintenance section of this Plan.

Public Opinion Survey

An online survey was conducted via GoogleForms, to help gain an understanding of what hazards truly concern the NSV region residents. The poll was designed using the FEMA reference worksheet provided in the "Local Mitigation Planning Handbook". Results from this poll were used in consideration during the Hazard Identification and Risk Assessment (HIRA) portion of the update's planning process.

The public outreach efforts were designed to solicit community input prior to submittal to the Virginia Department of Emergency Management and again, prior to adoption by a participating jurisdiction. In addition, the draft Plan 2018 update was available for review by soliciting surrounding localities, business, and other agencies for comment. In order to gain as much participation as possible, the poll was promoted via flyers and public announcements, including a local radio announcement.

Comments received on the Plan were reviewed by NSVRC and presented to the Steering Committee. In addition, the Plan update was announced for review directly for review and comment by the following: neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process. In addition, existing plans, reports and studies available were reviewed to provide information incorporated into this Plan update.

Survey results

Public concerns rendered from the 2018 Northern Shenandoah Valley Region Hazard Mitigation Public Opinion Survey, seemed to mostly align with the results of the 2012 survey. The hazards that were of high concern to survey respondents were severe winter weather, high winds and wildfire. Flooding and drought were also noted as being of a higher concern in areas of the region.

The questionnaire revealed a lot of important information about how the public perceives the way their community responds to catastrophe. The majority of respondents rated their NSVR community officials as having responded well to providing emergency relief, but can still use improvement. When asked if they felt their community would effectively respond to a disaster, if it were to strike tomorrow, the majority of respondents said yes.

The questionnaire also revealed an overall public willingness to participate and be proactive in assisting leaders and officials in safeguarding all aspects of the community, through the use of effective planning techniques. As a maintenance item, a poll of similar nature will be conducted on a yearly basis, and results will be used to continually gauge the effectiveness of the Hazard Mitigation Plan.

Additional results from the poll can be found in the public outreach documents in Appendix C. The information from this survey was used to update/confirm the hazards rankings from the 2012 plan. These rankings are described in Table 4.3, found in chapter 4 of this plan.

Final Draft Review

This plan was prepared and reviewed in accordance with the collaborative process outlined in Section 322 of the Stafford Act, to facilitate cooperation between state and local authorities. The identification of, and planning for, disaster response will reduce impacts from natural hazards and result in timely allocation of funds to reduce risks.

A draft of the plan review commenced in early December of 2017. The 2018 Plan Update was presented to the NSVRC commission board members at the January 2018 meeting, and left open for comment until it was sent for state review. The plan was also given a final review by members of the Northern Valley Emergency Planning Team prior to state delivery, at their January 2018 meeting. Any comments received after the plan has been sent for state and federal review, will be catalogued by NSVRC staff and addressed in future maintenance review meetings, as outlined in chapter 7 of this plan.

After the draft plan was approved by the steering committee it was sent to the offices of neighboring community governments, local and regional agencies and various other Hazard Mitigation Planning related organizations. Upon approval, VDEM will forward the Plan to FEMA Region III office for federal review and approval.

Plan Adoption

Following approval from FEMA, each participating jurisdiction will consider adoption of this Plan update. The resolutions for adoption will be presented as part of each City and Town Council and County Board of Supervisor meeting agendas during regularly scheduled meetings. These meetings are publicly advertised by law and will provide the public an additional opportunity to comment on this Plan update. The Steering Committee and or NSVRC staff is scheduled to present a summary of the Plan to each local elected body prior to their consideration of adoption.

The 2012 NSV Regional Hazard Mitigation Plan served as a springboard for the planning team and steering committee to determine a process to update this Plan. The 2012 plan expires April 8, 2018. The steering committee discussed the organization of the Plan and reviewed strategies considered for adoption, with the understanding that the process should be completed prior to the 2012 plan's expiration.

The committee meetings provided data review, evaluated data, ranked hazards, evaluated capacity to respond to disasters, identified and reviewed regional and local strategies, noted areas for improved regional emergency response coordination, articulated general training desires, and guided the outreach efforts (development of a regional website and a series of media advisories) for locality and public education to raise awareness of hazard mitigation and the Plan update. The committee member's developed understanding of specific threats to their community will provide a vital role in conveying the importance of adopting the updated plan, to their respective officials and public alike.

The emergency response coordinators in the NSV Region have cultivated excellent communication and cooperation in efforts to respond to disasters. This Plan update was designed to identify opportunities to encourage continued coordinated regional response to disasters. The update also facilitates funding for local projects important for reducing the adverse impacts brought on by natural disasters. The presentation of the 2018 Hazard Mitigation Plan Update should be met with the understanding that it is a crucial element to the overall resilience of the NSV Region communities, especially in terms of receiving adequate federal aid in times of dire need.

To satisfy multi-jurisdictional participation requirements, the City, Counties and local Towns were invited to participate in mitigation planning meetings, respond to Capability Assessment inquiries, rank hazards, review, evaluate and prioritize strategies and mitigation projects including County or Town-level goals and mitigation actions, and consider adoption of this Plan. Each locality participated at a level commensurate with staff capacities and each participating jurisdiction will consider adoption of this Regional Hazard Mitigation separately. The localities will commit to the plan maintenance procedures outlined in this Plan and will monitor and update their strategies on a regular basis. Annual updates of this Plan will occur at the end of each calendar year, beginning a year after the Plan is adopted, as outlined in chapter 7 of this Plan.

Chapter 3: Regional Setting

NSVRC Jurisdictional Composition

The Northern Shenandoah Valley Region covers approximately 1,645 square miles and is comprised of 5 Northern Virginia counties, their respective towns, and the city of Winchester. These jurisdiction's local governments work together under the Northern Shenandoah Valley Regional Commission, to pursue common planning goals and work together on regional issues. They are also home to 18 separate sheriff's offices and police departments, 48 fire/rescue stations, and 3 major hospitals. The region as a whole falls under the Virginia State Police Region II jurisdiction.

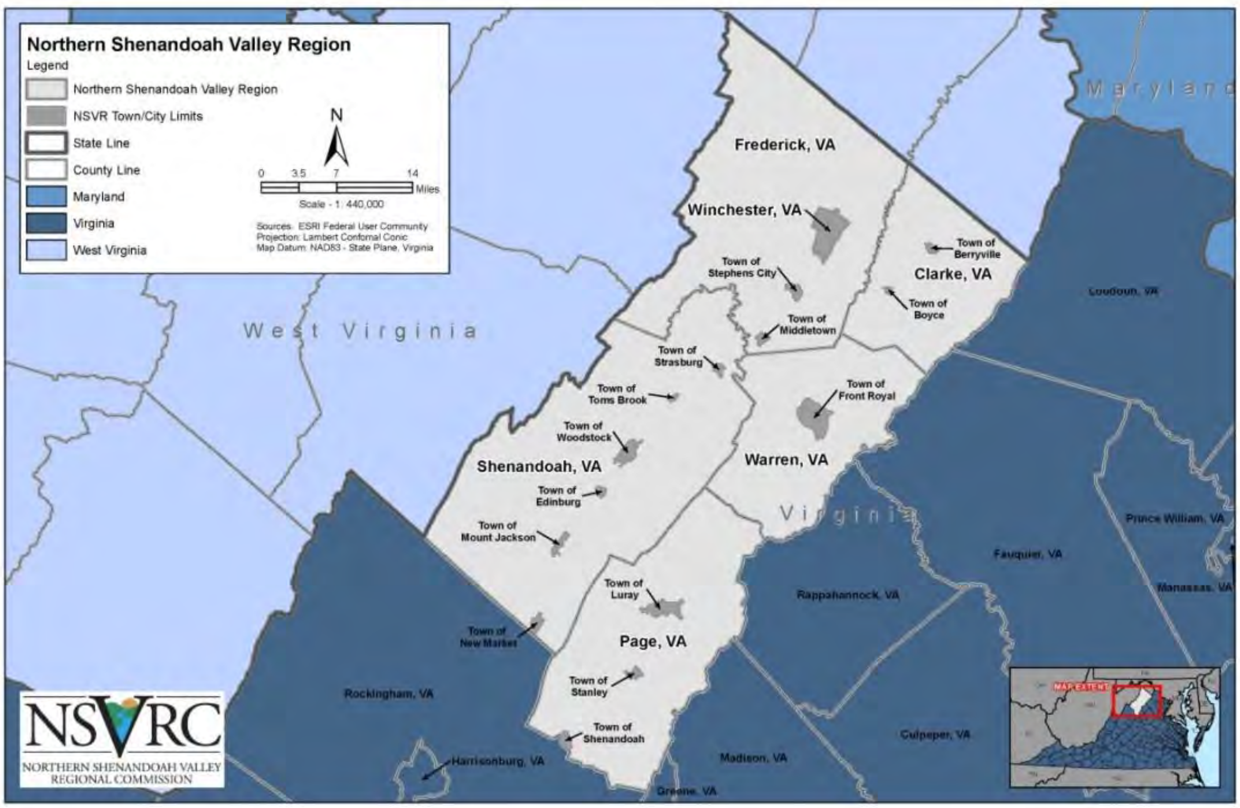


Figure 3.1 – Northern Shenandoah Valley Region - Source: ESRI, NSVRC

Planning Area Description

The area served by the Northern Shenandoah Valley Regional Commission is located in the northern tip of Virginia, west of the Washington, DC, metropolitan area. The region is made up of Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, and the Towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New Market, Shenandoah, Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock. Table 3.1 lists the land area of each of the communities in the PDC as well as the population density and housing unit density. This information is a key component in determining the risk to communities from natural hazards.

Table 3.1 - Northern Shenandoah Valley Region Population Density and Housing Unit Density		
Locality - (Area)	Population Density	Housing unit density
Clarke County - (175.9 sq mi)	**14,374**	**36**
Berryville (2.3 sq mi)	*4,185*	781
Boyce (0.4 sq mi)	*589*	650
Frederick County - (413.5 sq mi)	**84,421**	**80**
Middletown (0.8 sq mi)	*1,265*	698
Stephens City (2.4 sq mi)	*1,829*	366
Page County - (310.8 sq mi)	**23,654**	**37**
Luray (4.8 sq mi)	*4,895*	464
Shenandoah (2.2 sq mi)	*2,373*	550
Stanley (1.4 sq mi)	*1,689*	567
Shenandoah County - (508.3 sq mi)	**43,175**	**41**
Edinburg (0.8 sq mi)	*1,041*	714
Mount Jackson (2.7 sq mi)	*1,994*	336
New Market (2.0 sq mi)	*2,146*	522
Strasburg (3.7 sq mi)	6,398	853
Toms Brook (0.1 sq mi)	258	1,220
Woodstock (3.9 sq mi)	5,097	586
Warren County - (213.8 sq mi)	**39,155**	**76**
Front Royal (10.3 sq mi)	14,440	616
Winchester City - (9.2 sq mi)	27,516	**1,294**
NSVR Total - (1,622.3 sq mi)	232,295	**62**

Table 3.1 – Northern Shenandoah Valley Region Population Density and Housing Unit Density – January 1, 2016 - Source: U.S. Census Bureau

Location, Natural Environment and Climate

Location

Situated within the Northern Virginia portion of the Appalachian Mountain Range, the Northern Shenandoah Valley lies approximately 50 miles east of the U.S. capitol of Washington, D.C. A more rural counterpart to its neighbors to the east, this region features a rural makeup of rolling hills and open farm land. Its western border is shared with West Virginia, and it's just a short distance from the state of Maryland.

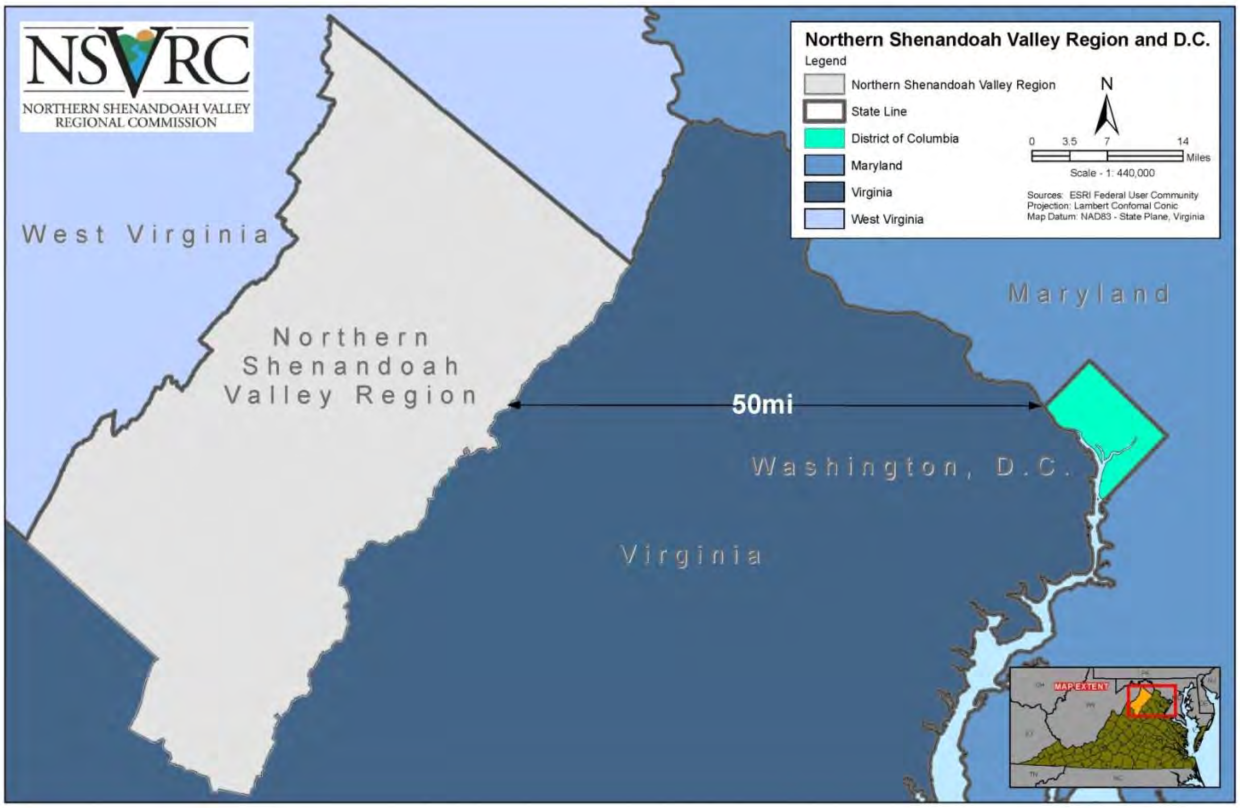


Figure 3.2 – Northern Shenandoah Valley Region and Washington D.C. - Source: ESRI, NSVRC

Landscape

Home to over 7,000 linear miles of rivers and streams, the region intersects 78 NRCS recognized watershed boundaries, which intersect over 36,000 acres of NWI inventoried wetlands. Flowing south to north, over 300 miles of the Shenandoah River and its branches run through the central part of the valley. It's separated from Virginia's Piedmont region by the Blue Ridge Mountain chain. Lying just within the eastern border of Page County is the region's highest point, known as Stony Man, rises to 4000 feet above sea level (USGS). Clarke's highest peak is Buzzard Hill, Frederick's is Pinnacle, Shenandoah's is Mill Mountain, Warren's is Hogback Mountain, and the City of Winchester's highest point is Bower's Hill.

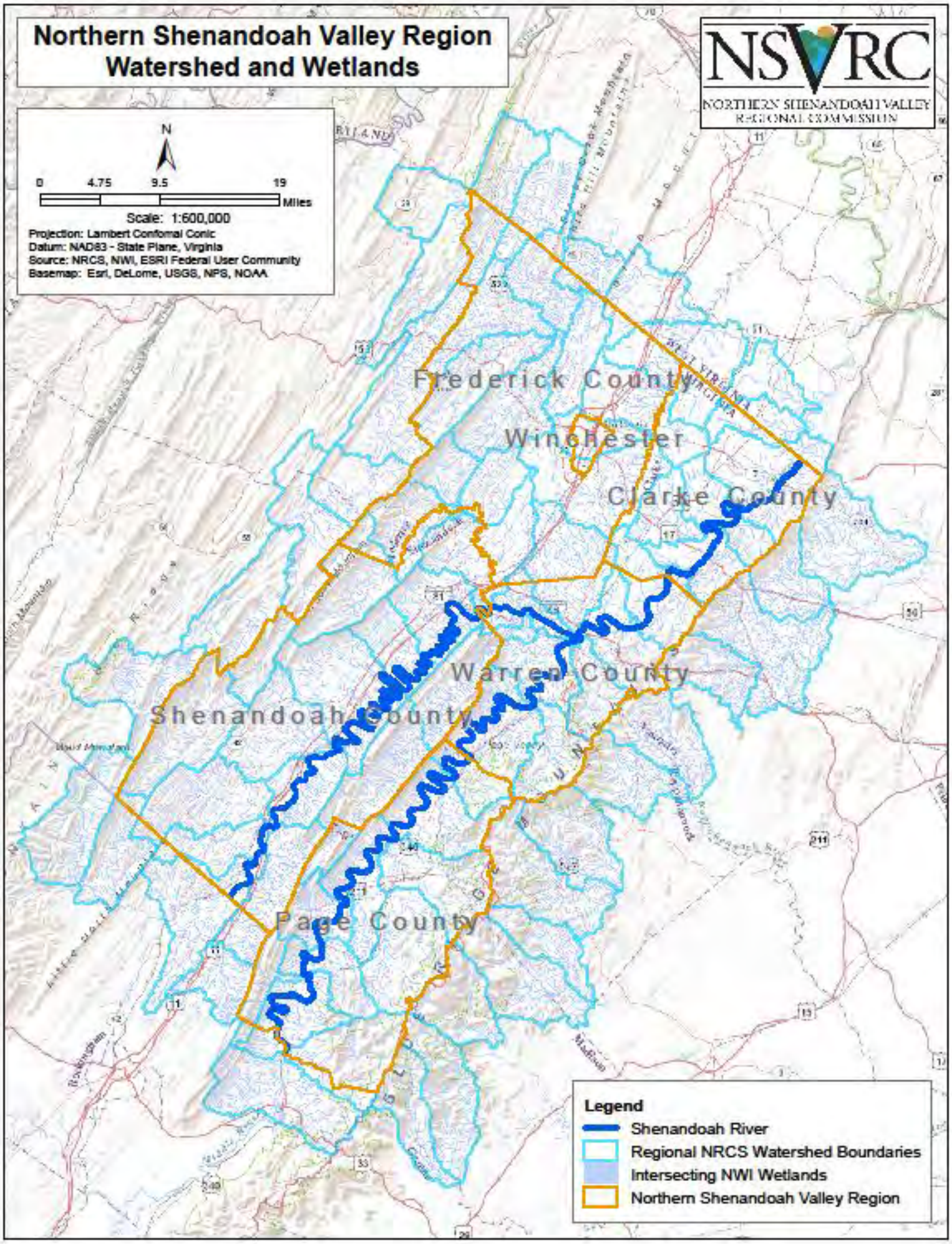


Figure 3.3 – Northern Shenandoah Valley Region Watershed and Wetlands - Source: ESRI, USGS, USDA, NOAA

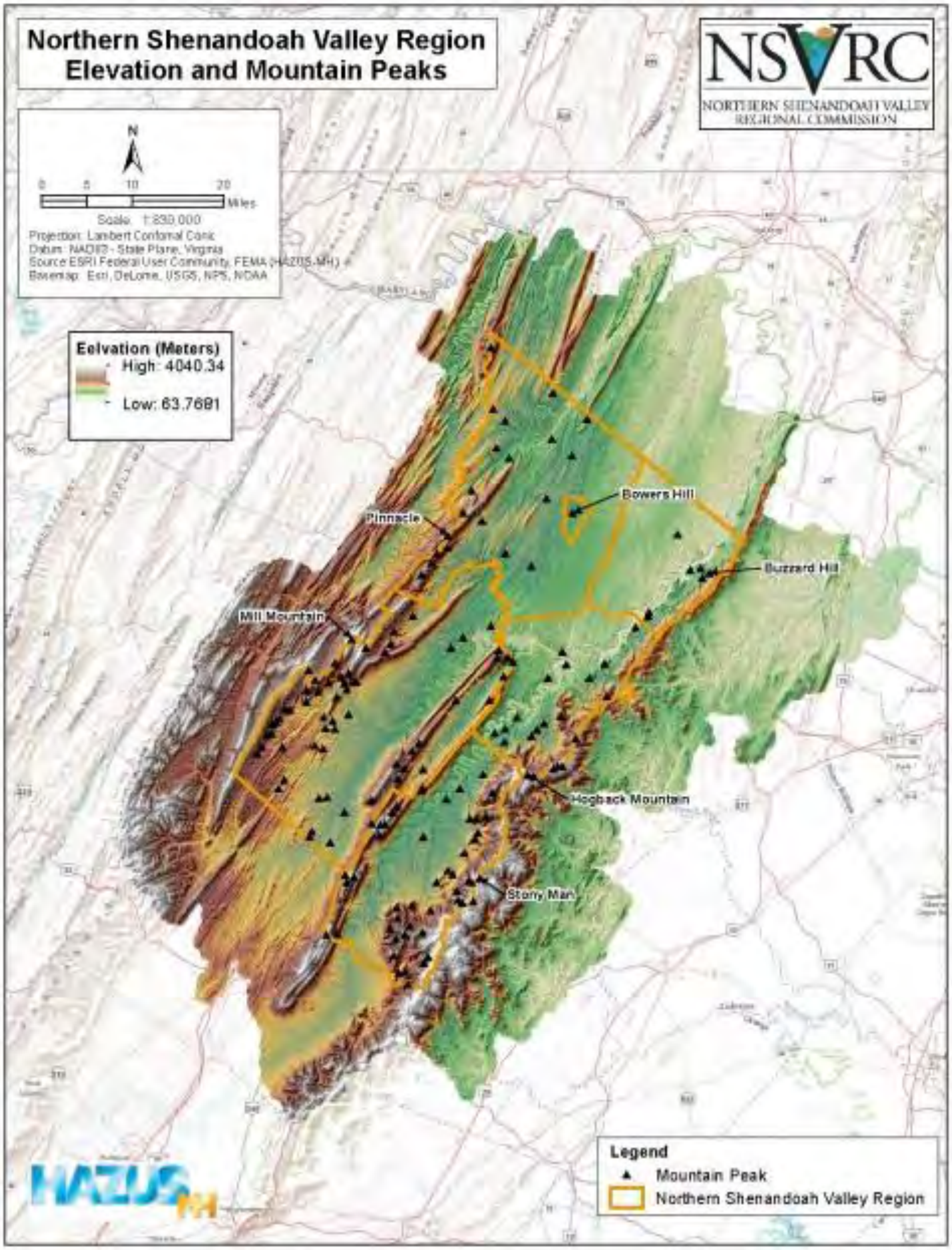


Figure 3.4 – Northern Shenandoah Valley Region Elevation and Mountain Peaks - Source: ESRI, USGS, USDA, NPS, NOAA

Watersheds

The major watershed for the region is the Potomac River Basin. The Rappahannock River Basin borders the eastern side of the planning area while the James River Basin borders the southern portion of the region. Figure 3.5 illustrates the location of the major watershed boundaries for the planning district.

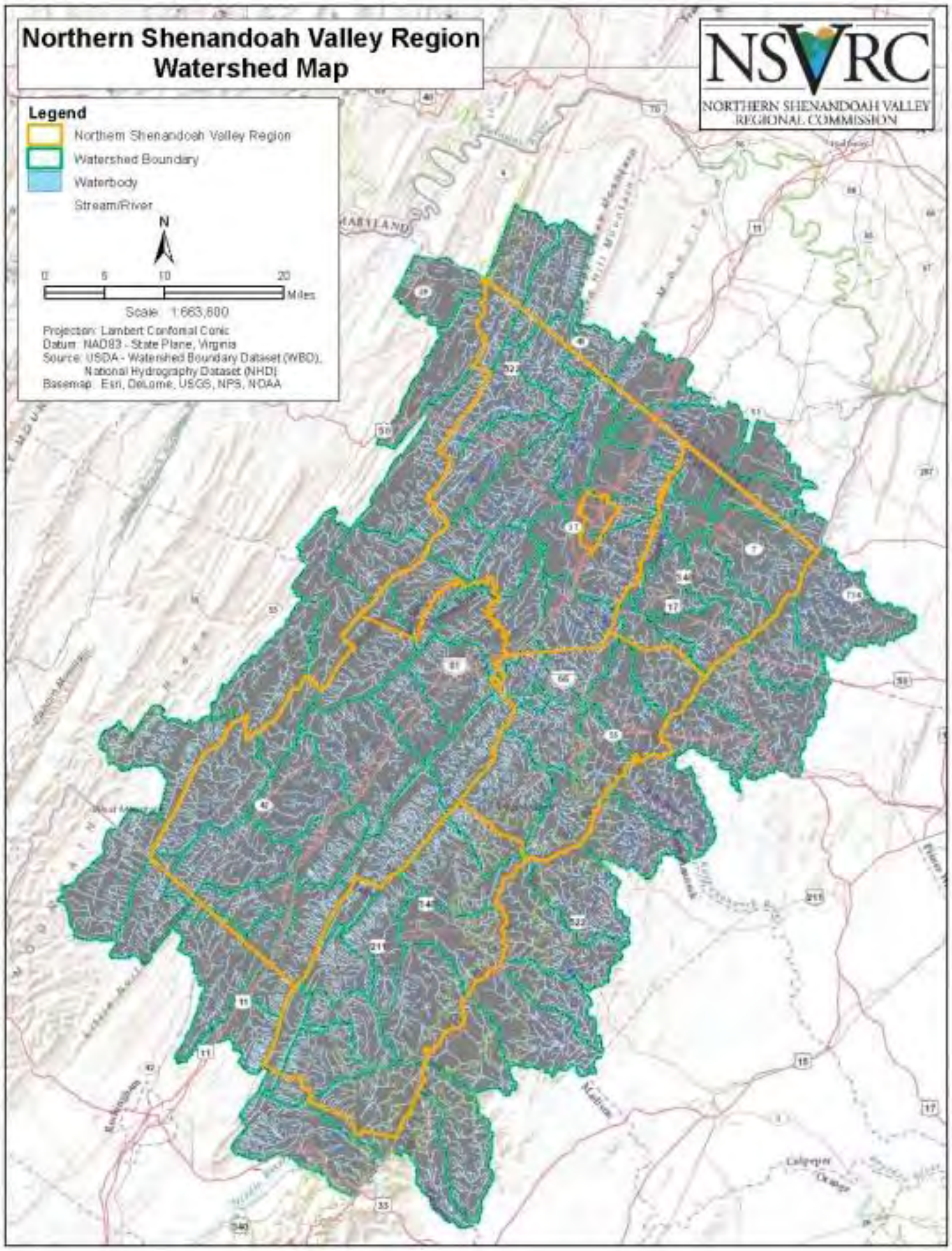


Figure 3.5 – Northern Shenandoah Valley Region Watershed Map – Source: ESRI, USGS, USDA, NPS, NOAA

Climate

There are numerous NOAA weather stations located within the NSV region. Data can be collected and analyzed from these stations using the NOAA Climate Data Online (CDO). The Winchester Regional (KOKV) weather station is recognized as a Large Scale Weather Station. The data presented in the table below was collected from the KOKV station.

Table 3.2 - Northern Shenandoah Valley Region Climate Statistics	
Average Annual Precipitation	38.02"
Average Annual Snowfall	16.7"
Average Annual Temperature	52.6°
Average Annual Max Temp	64.9°
Average Annual Min Temp	40.4°

Table 3.2 – Northern Shenandoah Valley Region Climate Statistics – Source: NOAA

The climate of the Shenandoah Valley, particularly regarding precipitation, is strongly influenced by the surrounding mountains. When moist air flows toward Virginia from areas to the west and northwest, it encounters the high relief of the Allegheny Mountain system to the west of the Shenandoah Valley. As warm air is forced up the face of a mountain, it cools, condenses and ensuing precipitation occurs. This process is known as Orographic Uplift. The NSV region experiences rainfall this uplift so as most precipitations falls on the Alleghenies. This leaves comparatively drier air to descend into the Valley and produce less precipitation. Likewise, when moist air from the nearby Atlantic Ocean flows across Virginia from the east, it encounters the Blue Ridge Mountains to the east of the Shenandoah Valley. The same orographic lifting usually results in lower precipitation amounts in the Valley. This double "rain shadow" effect puts the Shenandoah Valley in the driest portion of Virginia and makes it one of the driest locations in the eastern United States.

Typical annual precipitation amounts for nearby stations on the east-facing slopes of the Blue Ridge Mountains run about ten inches higher than the Shenandoah Valley (around 48 inches as opposed to 38 inches). Statewide average annual precipitation is around 40-44 inches.

The general mechanisms for precipitation change throughout the course of the year. Larger-scale mid-latitude cyclones and associated frontal passages predominate the colder months and smaller-scale thunderstorm activity usually providing most of the rainfall in the warmer months. The Shenandoah Valley, along with the rest of Virginia, experiences no distinct "dry" or "wet" seasons with respect to precipitation. Nonetheless, the normally high rates of evapotranspiration in the summer months usually lead to an overall loss of moisture, while the colder months allow for the replenishment of deep soil and groundwater reserves. In addition, the varied height and orientation of the flanking mountains can create large differences in precipitation amounts at smaller scales. This is especially true during the summer months, when the primary source of rainfall in Virginia is the thunderstorm.

The predominant flow of surface winds is generally up and down the roughly 160-mile length of the Valley (northeasterly and southwesterly directional categories). Diurnal heating and cooling also gives rise to a mountain and valley breeze, which circulates air from higher surrounding elevations to the Valley floor and up again. Summer average temperatures in the Valley are in the mid-70's (°F) and rarely reach the 100° mark, while winter temperatures average in the mid- 30's. The freeze-free growing season averages about six months, from mid-April to mid- October, though local microclimates and elevational differences can bring considerable variation.

Rainfall is drained out of the Valley through a series of tributaries and streams that flow into the Shenandoah River, flowing northward to the Potomac River.

Population Profile

Population density is number of people per square mile. Figure 3.6 displays the regional population density according to the U.S. Census designated census blocks. The maps show heavier density within the incorporated towns throughout the region. Also, we see dense areas that have developed east of Winchester and Stephens City. We can also see that there are dense neighborhoods scattered throughout the mountainous areas of Clarke County, and Northeastern Warren County.

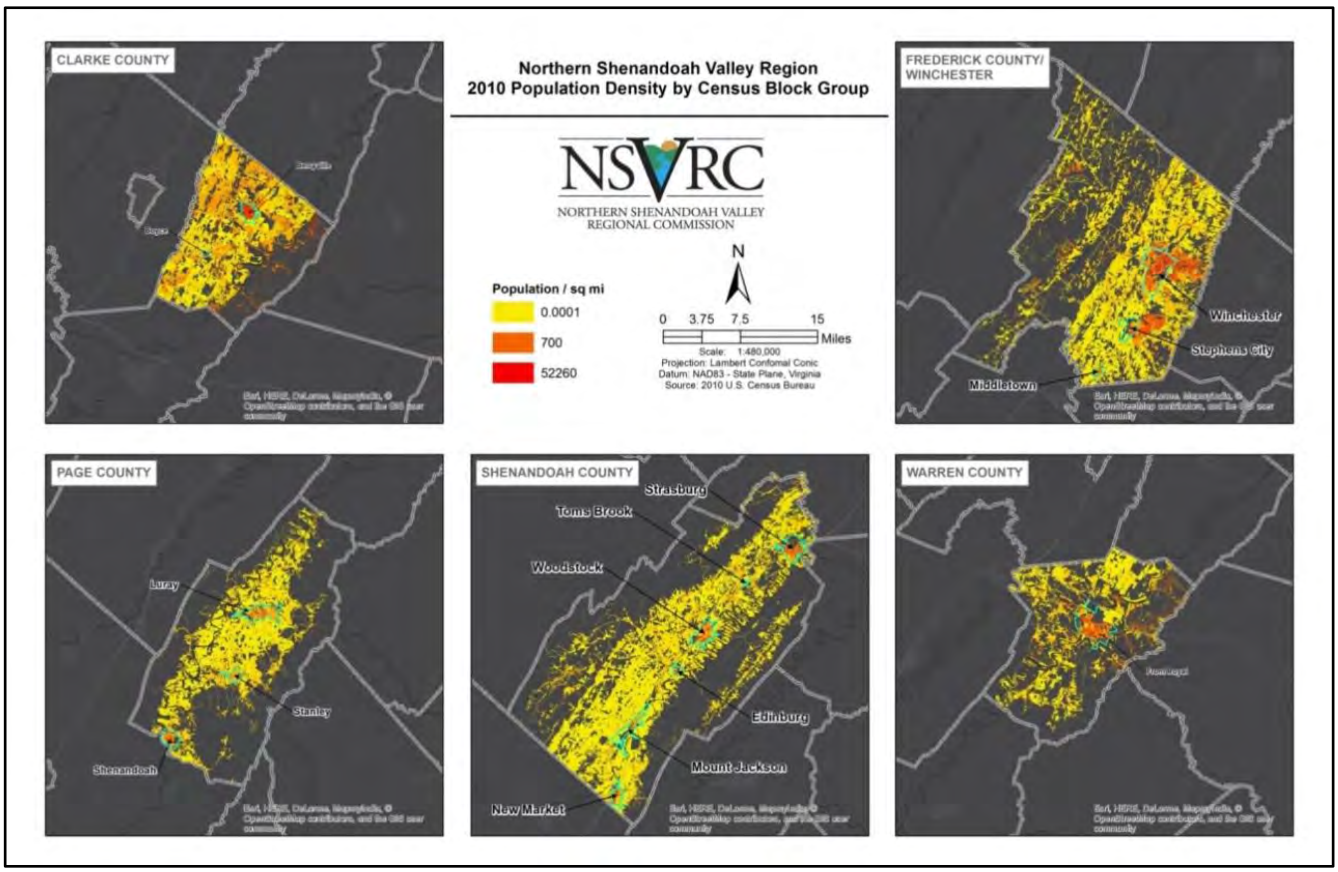


Figure 3.6 - Northern Shenandoah Valley Region 2010 Population Density per Census Block, per 2010 U.S. Census – Source : U.S. Census Bureau

Table 3.3 - Northern Shenandoah Valley Region Total Population – U.S. Census Bureau (July 1, 2016)		
Locality	2016 Population	Change since last plan
Clarke County	**14,374**	**+231**
Berryville	*4,185*	*+20*
Boyce	*589*	*-59*
Frederick County	**84,421**	**+6,024**
Middletown	*1,265*	*-4*
Stephens City	*1,829*	*-36*
Page County	**23,654**	**-384**
Luray	*4,895*	*-8*
Shenandoah	*2,373*	*-113*
Stanley	*1,689*	*-300*
Shenandoah County	**43,175**	**+1,099**
Edinburg	*1,041*	*-108*
Mount Jackson	*1,994*	*+53*
New Market	*2,146*	*-166*
Strasburg	*6,398*	*+50*
Toms Brook	*258*	*+23*
Woodstock	*5,097*	*-2*
Warren County	**39,155**	**+1,588**
Front Royal	*14,440*	*-97*
Winchester city	**27,516**	**+1,186**
NSVR (County) Total	**232,295**	**+8,997**

Table 3.3 - Northern Shenandoah Valley Region Total Population, July 1, 2016 – Source: U.S. Census Bureau

Virginia's population statistics are recorded by county, city, town and planning district. Cities and counties are separate political entities and do not have any overlap in data. The 2010 U.S. Census total population recorded for the Northern Shenandoah Valley is 232,195. The most populous NSVRC jurisdiction is Frederick County, with a population of 78,305. The City of Winchester has the highest population density, with a rate of about 2,990 persons per sq mi. The top 3 towns in terms of population density according to the 2016 U.S. Census estimates are Berryville, Strasburg and Middletown. Table 3.4 lists the population and population density per county/town.

Table 3.4 - Northern Shenandoah Valley Region County/Town Population Density – U.S. Census Bureau (July 1, 2016)			
Locality - (Area)	**Total Population**	**Population Density 2012**	**Population Density 2016**
Clarke County - (175.9 sq mi)	**14,374**	**80.4**	**81.7**
Berryville (2.3 sq mi)	*4,185*	*1,810.8*	*1,819.6*
Boyce (0.4 sq mi)	*589*	*259.2*	*235.6*
Frederick County - (413.5 sq mi)	**84,421**	**189.6**	**204.2**
Middletown (0.8 sq mi)	*1,265*	*1,015.2*	*1,012.0*
Stephens City (2.4 sq mi)	*1,829*	*777.1*	*762.1*
Page County - (310.8 sq mi)	**23,654**	**77.3**	**76.1**
Luray (4.8 sq mi)	*4,895*	*1,021.5*	*1,019.8*
Shenandoah (2.2 sq mi)	*2,373*	*1,130.0*	*1,078.6*
Stanley (1.4 sq mi)	*1,689*	*1,420.7*	*1,206.4*
Shenandoah County - (508.3 sq mi)	**43,175**	**82.8**	**84.9**
Edinburg (0.8 sq mi)	*1,041*	*919.2*	*832.8*
Mount Jackson (2.7 sq mi)	*1,994*	*718.9*	*738.5*
New Market (2.0 sq mi)	*2,146*	*1,156.0*	*1,073.0*
Strasburg (3.7 sq mi)	*6,398*	*884. 6*	*1,729.2*
Toms Brook (0.1 sq mi)	*258*	*23.5*	*25.8*
Woodstock (3.9 sq mi)	*5,097*	*1,307.4*	*1306.9*
Warren County - (213.8 sq mi)	**39,155**	**175.7**	**183.1**
Front Royal (10.3 sq mi)	*14,440*	*1,411.4*	*1,401.9*
Winchester City - (9.2 sq mi)	**27,516**	**2,861.9**	**2,990.9**
NSVR Total - (1,622.3 sq mi)	**232,295**	**148.7**	**143.2**

Table 3.4 - Northern Shenandoah Valley Region Population Density, July 1, 2016 – Source: U.S. Census Bureau

The University of Virginia's Weldon Cooper Center for Public Service provides intercensal population estimates, to aid in planning purposes across agencies statewide. The Weldon Cooper Center develops an annual population approximation according to the population count on July 1st of the previous year. The center estimates that the Regional 2016 total population is 232,295, which is a 5,589 increase from 2012 Hazard Mitigation Plan Update. Table 3.5 displays the Weldon Cooper Center's year 2010-2016 county population estimates.

Table 3.5 - Intercensal Population Estimates: 2010-2016

Locality	2010 Census	Intercensal Population Estimate						
		2010	2011	2012	2013	2014	2015	2016
Virginia	**8,001,024**	**8,025,514**	**8,096,604**	**8,185,867**	**8,260,405**	**8,326,289**	**8,382,993**	**8,411,808**
Clarke County	14,034	14,067	14,211	14,276	14,148	14,323	14,206	14,374
Frederick County	78,305	78,834	79,156	80,118	81,207	82,059	82,623	84,421
Page County	24,042	24,058	24,155	24,215	24,079	24,083	23,719	23,654
Shenandoah County	41,993	42,172	42,114	42,812	42,889	42,916	42,228	43,175
Warren County	37,575	37,729	37,688	38,077	38,387	38,814	38,829	39,155
Winchester City	26,203	26,265	26,167	27,208	26,961	27,200	27,515	27,516
NSVRC	232,295	223,125	223,490	226,706	227,671	229,395	229,120	232,295

Table 3.5 - Intercensal Population Estimates: 2010-2016 – Source: U.S. Census Bureau / Weldon Cooper Center

According to these projections, the regional population has increased by approximately 8,322 persons. Winchester City still has the highest ranking population density, recording nearly 3,000 persons per square mile, increasing by approximately 150 persons per square mile in comparison the 2010 census record. Table 3.6 displays the projected county population density for year 2016.

Table 3.6 - Northern Shenandoah Valley Region County Population Density - 2016 Projections

Locality - (Area)	Total Population	Population Density
Clarke County - (175.9 sq mi)	14,374	81.7
Frederick County - (413.5 sq mi)	84,421	204.2
Page County - (310.8 sq mi)	23,654	76.1
Shenandoah County - (508.3 sq mi)	43,175	84.9
Warren County - (213.8 sq mi)	39,155	183.1
Winchester City - (9.2 sq mi)	27,516	2,990.9
NSVRC Total - (1,622.3 sq mi)	**232,295**	**143.2**

Table 3.6 - Northern Shenandoah Valley Region County Population Density – July 1, 2016 Projections – Source: U.S. Census Bureau / Weldon Cooper Center

The Weldon Cooper Center's current 2020-2040 population projections see an increase of 332,465 persons for the state of Virginia, by the year 2020. The center projects the NSV region will increase by 4,818 persons. Table 3.7 exhibits the center's population projections for year 2020-2040.

Table 3.7 – Northern Shenandoah Valley Region Population Projections - 2020, 2030, 2040

Locality	Total Population		
	2020	2030	2040
Virginia	**8,744,273**	**9,546,958**	**10,201,530**
Clarke County	14,337	15,266	15,965
Frederick County	86,574	101,471	114,663
Page County	23,387	23,583	23,450
Shenandoah County	42,363	46,803	50,507
Warren County	39,925	44,444	48,256
Winchester city	28,705	31,107	33,031
NSVRC	**235,292**	**262,674**	**285,873**

Table 3.7 – Northern Shenandoah Valley Region Population Projections - 2020, 2030, 2040 – Source: Weldon Cooper Center

The Weldon Cooper Center's 2020 population projections yield a regional population density increase of 8.13, resulting in a 2020 population regional density estimate of 145.04 persons per sq mi. Table 3.8 exhibits the center's population density projections for year 2020-2040.

Table 3.8 - NSVRC Population Density Projections - 2020-2040 – U.S. Census Bureau (July 1, 2016)

Locality - (Area)	Total Population					
	2020	2020 Density	2030	2030 Density	2040	2040 Density
Clarke County - (175.9 sq mi)	15,266	86.79	15,965	90.76	14,276	81.16
Frederick County - (413.5 sq mi)	101,471	245.40	114,663	277.30	80,118	193.76
Page County - (310.8 sq mi)	23,583	75.88	23,450	75.45	24,215	77.91
Shenandoah County - (508.3 sq mi)	46,803	92.08	50,507	99.37	42,812	84.23
Warren County - (213.8 sq mi)	44,444	207.88	48,256	225.71	38,077	178.10
Winchester City - (9.2 sq mi)	31,107	3,381.20	33,031	3,590.29	27,208	2,957.39
NSVR Total - (1,622.3 sq mi)	9,546,958	5,884.83	10,201,530	6,288.31	8,185,867	5,045.84

Table 3.8 - NSVRC Population Density Projections - 2020-2040 – Source: U.S. Census Bureau / Weldon Cooper Center

Shenandoah County possesses the largest proportion of elderly persons, with an average of 21.2% of its inhabitants being age 65 or older, around 2.6% higher than the regional average. Berryville, Luray, New Market, and Woodstock all have elderly populations that exceed 20% of their recorded populaces.

Frederick County possesses the largest proportion of younger individuals, with an average of 23.1% of its inhabitants being under the age of 18, around 1.6% higher than the regional average. Luray, Shenandoah, Stanley, and New Market are the only jurisdictions listed that do not exceed 20%. The town of Toms Brook possesses the highest proportion of younger individuals, with 32.3% of its population being under the age of 18. Table 3.9 displays the percentage of under 18 and over 65 years of age, per jurisdiction.

Table 3.9 - Northern Shenandoah Valley Region Median Age		
Locality	2012 Median Age	2016 Median Age
Clarke County	**44.7**	**45.4**
Berryville	*37.2*	*41.6*
Boyce	*44.2*	*32.5*
Frederick County	**38.3**	**40.3**
Middletown	*33.4*	*31.6*
Stephens City	*34.7*	*35.5*
Page County	**43.0**	**44.7**
Luray	*47.4*	*44.6*
Shenandoah	*39.6*	*41.3*
Stanley	*38.9*	*41.2*
Shenandoah County	**42.7**	**44.8**
Edinburg	*37.7*	*41.5*
Mount Jackson	*35.0*	*33.7*
New Market	*41.7*	*50.0*
Strasburg	*35.8*	*35.7*
Toms Brook	*42.7*	*31.6*
Woodstock	*39.2*	*38.5*
Warren County	**39.8**	**40.8**
Front Royal	*40.4*	*38.5*
City of Winchester	**35.6**	**37.0**
NSVRC Average	**39.6**	**39.5**

Table 3.9 - Northern Shenandoah Valley Region Age Profile, July 1, 2016 – Source: U.S. Census Bureau

Populations at Risk

The eight factors to identify populations at risk included:

1. **Socio-economic status**
2. **Wealth**
3. **Elderly populations**
4. **Female heads of Large Households in densely populated areas**
5. **Rural areas**
6. **Non-English proficient populations (English as a second language populations, etc.)**
7. **Female labor force**
8. **Households living in Manufactured Housing**

A challenge in emergency management and in all government support services is to include the immigrant population in the NSV Region since these residents are not fully captured by traditional Census or this vulnerability analysis. English as the secondary language is a large portion of much of the Valley, especially for migrant workers in the poultry processing plants and orchard pickers.

The factors that attract businesses and people to the area present the greatest challenges to regional Emergency Managers and cause significant hazard mitigation challenges including: growth, dense populations, over-taxed transportation routes, communication, and knowledge of how to mitigate vulnerable buildings and prepare for disasters.

Households Profile

The U.S. Census Bureau classifies a household as the number of people who occupy a housing unit (such as a house or apartment) as their usual place of residence. The 2010 Census documented the Northern Shenandoah Valley as accounting for approximately 2.8% of Virginia's total households. Frederick County possesses the largest number within the region, making up approximately 34% of the region's total. Table 3.10 displays the July 1, 2016 U.S. Census recorded households for Virginia and the NSVRC jurisdictions.

Table 3.10 – Northern Shenandoah Valley Region - Total Households

Locality	2012 Total	2016 Total	Increase
Virginia	**3,365,855**	**3,445,357**	**79,502**
Clarke County	6,226	6,283	57
Frederick County	31,341	35,502	4,161
Page County	11,577	11,647	70
Shenandoah County	20,817	21,066	249
Warren County	15,955	16,146	191
City of Winchester	11,866	11,907	41
NSVRC	**97,782**	**102,551**	**4,769**

Table 3.10 – Northern Shenandoah Valley Region - Total Households – July 1, 2016 – Source: U.S. Census Bureau

The average household income across the entire Northern Shenandoah Valley is $56,873. Clarke County's median household income ranks the highest among NSVRC jurisdictions at $71,295 - $14,442 *greater than the regional Average*. Page County's median household income ranks lowest amongst the region, at $43,895 - *$12,978 lower than the regional average*. Table 3.11 displays the 2010 regional household income U.S. Census data.

Table 3.11 - Northern Shenandoah Valley Region Median Household Income – U.S. Census Bureau (July 1, 2016)		
Locality	2012 Median Household Income	2016 Median Household Income
Virginia	**$63,636**	**$66,149**
Clarke County	**$80,106**	**$71,986**
Berryville	*$68,029*	*$56,591*
Boyce	*$74,286*	*$72,083*
Frederick County	**$67,694**	**$68,929**
Middletown	*$49,868*	*$60,625*
Stephens City	*$49,097*	*$55,625*
Page County	**$43,745**	**$45,030**
Luray	*$50,450*	*$43,359*
Shenandoah	*$43,152*	*$40,139*
Stanley	*$31,750*	*$32,895*
Shenandoah County	**$49,953**	**$50,450**
Edinburg	*$46,061*	*$40,375*
Mount Jackson	*$35,294*	*$35,750*
New Market	*$32,031*	*$36,815*
Strasburg	*$44,515*	*$50,676*
Toms Brook	*$45,893*	*$55,750*
Woodstock	*$41,960*	*$35,267*
Warren County	**$61,693**	**$63,734**
Front Royal	*$46,421*	*$47,981*
Winchester City	**$45,959**	**$46,466**
NSVR Average	**$51,028**	**$50,316**

Table 3.11 - Northern Shenandoah Valley Region Median Household Income (in 2016 dollars, 2012-2016) - Source: U.S. Census Bureau

Employment Data and Labor Force Analysis

According to the Virginia Employment Commission (VEC), the top employers in the Northern Shenandoah Valley are listed below (in alphabetical order). These top employers are anticipated to continue to grow throughout the region through 2040 (per Virginia Employment Commission). The VEC recognizes the NSVR region as belonging to its 'Shenandoah Valley (LWIA IV) Region' and lists the following as the top 15 employers throughout. Facilities associated with these employers and those listed for individual jurisdictions, should be considered to have higher occupancies and higher concentrations of people during operational hours. Each of the employers listed in Table 3.12 are supported by a labor force of over 1,000 employees.

Table 3.12 - Top 15 Shenandoah Valley (LWIA IV) Employers
Valley Health System
James Madison University
Wal-Mart
The Rockingham Memorial Hospital
Frederick County Public School Board
Rockingham County Public School Board
Augusta County School Board
Augusta Medical Center
Cargill Meat Solutions
Food Lion
R.R. Donnelley and Sons Company
Lowes' Home Centers, Inc.
Shenandoah County School Board
Washington and Lee University
Target Corp

Table 3.12 - Top 15 Shenandoah Valley (LWIA IV) Employers – Source: VA Employment Commission

Table 3.13 features Clarke County's top 5 employers, with a labor force totals ranging from of 100 – up to 500 individuals.

Table 3.13 - Top 5 Clarke County Employers
Berryville Graphics
Clarke County School Board
Grafton School, Inc.
Clarke County
Ggnsc Berryville LLC

Table 3.13 - Top 5 Clarke County Employers – Source: VA Employment Commission

Table 3.14 features Frederick County's top 5 employers, with a labor force totals ranging from of 500 – over 1,000 individuals.

Table 3.14 - Top 5 Frederick County Employers
Frederick County School Board
Navy Federal Credit Union
U.S. Department of Homeland Defense
Frederick County
Lord Fairfax Community College

Table 3.14 - Top 5 Frederick County Employers – Source: VA Employment Commission

Table 3.15 features Page County's top 5 employers. Page County School Board is listed by the VEC as employing 500 – 999 individuals, while the others listed possess a labor force with totals ranging from of 100 – up to 250 individuals.

Table 3.15 - Top 5 Page County Employers
Page County School Board
Page County
Wal-Mart
VF Jeanswear
DNC P&R at Shenandoah

Table 3.15 - Top 5 Page County Employers – Source: VA Employment Commission

Table 3.16 features Shenandoah County's top 5 employers. Shenandoah County School Board is listed by the VEC as employing over 1,000 individuals, George's Chicken employs 500 – up to 999, while the others listed possess a labor force with totals ranging from of 250 – up to 499 individuals.

Table 3.16 - Top 5 Shenandoah County Employers
Shenandoah County School Board
George's Chicken
IAC Strasburg LLC
R.R. Donnelley and Sons Company
Bowman Andros Products

Table 3.16 - Top 5 Shenandoah County Employers – Source: VA Employment Commission

Table 3.17 features Warren County's top 5 employers. Warren County School Board is listed by the VEC as employing 500 – 999 individuals, while the others listed possess a labor force with totals ranging from of 250 – up to 499 individuals.

Table 3.17 - Top 5 Warren County Employers
Warren County School Board
Valley Health System
Family Dollar Services
Axalta Coating Systems
Interbake Foods LLC / Aeortek

Table 3.17 - Top 5 Warren County Employers – Source: VA Employment Commission

Table 3.18 features the City of Winchester's top 5 employers. Valley Health System is listed by the VEC as employing over 1,000 individuals, while the others listed possess a labor force with totals ranging from of 500 – up to 999 individuals.

Table 3.18 - Top 5 Winchester City Employers
Valley Health System
Winchester Public Schools
Shenandoah University
Rubbermaid Commercial Products LLC
Wal-Mart

Table 3.18 – Top 5 Winchester Employers – Source: VA Employment Commission

Housing

The United States Census Bureau's American Community Survey inventoried 100,310 housing units throughout the entire Northern Shenandoah Valley region. Frederick County possesses 33,385 housing units, the most in the region. The highest housing unit density was recorded by Winchester, with a rate of 1,294 units per square mile. The highest occupancy rate recorded across the region is 96%, as noted for the towns of Boyce and Middletown. Table 3.19 displays the regional housing unit totals, the housing unit density, occupancy rates and median housing unit values.

Table 3.19 - Northern Shenandoah Valley Region Housing Units, Density, Occupancy Rates and Median Values – U.S. Census Bureau (July 1, 2016)

Locality - (Area)	Number of Units	Housing unit density	% Occupied	Median value of owner-occupied housing units
Clarke County - (175.9 sq mi)	**6,333**	**36**	**88%**	**$329,500**
Berryville (2.3 sq mi)	*1,796*	781	87%	$295,800
Boyce (0.4 sq mi)	*260*	650	96%	$296,400
Frederick County - (413.5 sq mi)	**33,381**	**80**	**92%**	**$243,600**
Middletown (0.8 sq mi)	*558*	698	96%	$163,500
Stephens City (2.4 sq mi)	*878*	366	90%	$171,700
Page County - (310.8 sq mi)	**11,674**	**37**	**81%**	**$176,000**
Luray (4.8 sq mi)	*2,227*	464	86%	$174,600
Shenandoah (2.2 sq mi)	*1,209*	550	84%	$143,700
Stanley (1.4 sq mi)	*794*	567	86%	$153,500
Shenandoah County - (508.3 sq mi)	**21,163**	**41**	**81%**	**$198,900**
Edinburg (0.8 sq mi)	*571*	714	84%	$159,000
Mount Jackson (2.7 sq mi)	*907*	336	85%	$130,100
New Market (2.0 sq mi)	*1,043*	522	91%	$191,200
Strasburg (3.7 sq mi)	*3,155*	853	88%	$182,400
Toms Brook (0.1 sq mi)	*122*	1,220	93%	$155,300
Woodstock (3.9 sq mi)	*2,287*	586	91%	$188,200
Warren County - (213.8 sq mi)	**16,268**	**76**	**89%**	**$213,500**
Front Royal (10.3 sq mi)	*6,348*	616	88%	$170,100
Winchester City - (9.2 sq mi)	**11,907**	**1,294**	**89%**	**$216,300**
NSVR Total - (1,622.3 sq mi)	**100,726**	**62**	**AVG: 89%**	**$229,633**

Table 3.19 - Northern Shenandoah Valley Region Housing Units, Density, Occupancy Rates and Median Values – July 1, 2016 – Source: U.S. Census Bureau

Manufactured housing communities consist of homes originally designed to be towed on their own chassis. These types of structures are at the highest risk of succumbing to extensive damage during times of natural disaster. They are also more likely to house elderly or low income residents. Figure 3.7 was generated using the HAZUS-MH plug in for ArcGIS. Shown on the map are concentrations of manufactured housing communities.

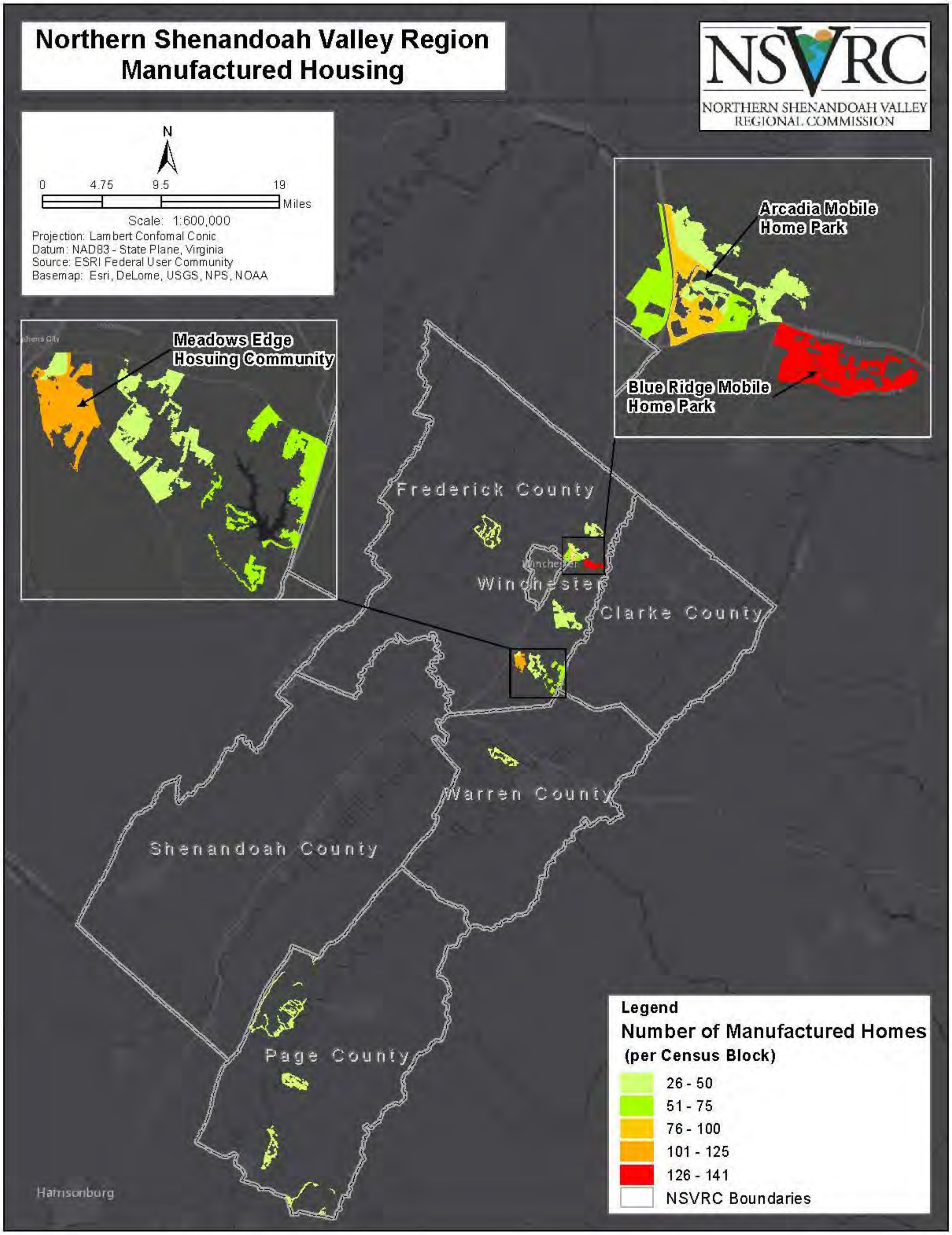


Figure 3.7 - Northern Shenandoah Valley Region Manufactured Housing Concentrations

Property Values

The following property values were recorded by the commissioner of revenue for each jurisdiction. These numbers are in accordance with the most up to date values.

Table 3.21 - Northern Shenandoah Valley Region Total Property Values			
Locality	**Taxable Structures**	**Nontaxable Structures**	**Total Property Values (January 1, 2017 Tax book)**
Clarke County	**$883,785,000**	**$67,843,100**	**$1,269,383,800**
Town of Berryville	$341,319,10	$38,137,600	$38,137,600
Town of Boyce	$44,279,700	$8,305,200	$52,584,900
Frederick County	**$6,149,85,467**	**$853,673,900**	**$853,673,900**
Town of Middletown	NDA	NDA	NDA
Town of Stephens City	NDA	NDA	NDA
Page County	**$876,062,945**	**$114,710,700**	**$990,773,645**
Town of Luray	$336,978,500	$49,750,100	$386,428,600
Town of Stanley	$120,398,300	$13,189,700	$133,588,000
Town of Shenandoah	$73,582,400	$16,162,100	$89,744,500
Shenandoah County	**$2,817,314,100**	**$470,471,900**	**$3,287,786,000**
Town of Edinburg	$59,197,300	$11,645,500	$70,842,800
Town of Mount Jackson	$116,405,400	$21,758,000	$138,163,400
Town of New Market	$123,725,400	$14,054,900	$137,780,300
Town of Strasburg	$416,538,900	$86,299,900	$502,838,800
Town of Toms Brook	$11,817,900	$2,149,600	$13,967,500
Town of Woodstock	$356,827,600	$145,712,700	$502,540,300
Warren County	**$1,963,908,900**	**$214,310,600**	**$2,178,219,500**
Town of Front Royal	$822,761,300	$296,666,200	$1,119,427,500
City of Winchester	**$2,051,450,600**	**$836,718,300**	**$2,888,168,900**

Table 3.21 - Northern Shenandoah Valley Region Total Property Values – January, 2016 – Source: Commissioner of the Revenue

Transitional Sheltering Assistance

In cases of displacement, those affected may become eligible for Transitional Sheltering Assistance (TSA). In conjunction with participating hotels, under this program, FEMA will cover the cost of the room and taxes. An interactive map has been produced by FEMA to display participating hotels. It can be found on the FEMA ArcGIS online portal (fema.maps.arcgis.com), and should be checked regularly for regional updates. The FEMA Helpline (800) 621-3362 should be contacted to confirm the inventory of participating hotels displayed on the map, and the establishment should be contacted to confirm availability of vacant rooms. The FEMA TSA webapp currently displays 3 FEMA designated evacuation hotels within the Northern Shenandoah Valley Region:

- Ramada Strasburg –
  - 35 Brandy Ct.
    Strasburg, VA 22657
    (540) 465-2444

- Quality Inn –
  - 10 S. Commerce St.
    Front Royal, VA 22630
    (540) 635-3161

- Days Inn –
  - 9360 George Collin Pkwy.
    New Market, VA 22844
    (540) 740-4100

Critical Facilities

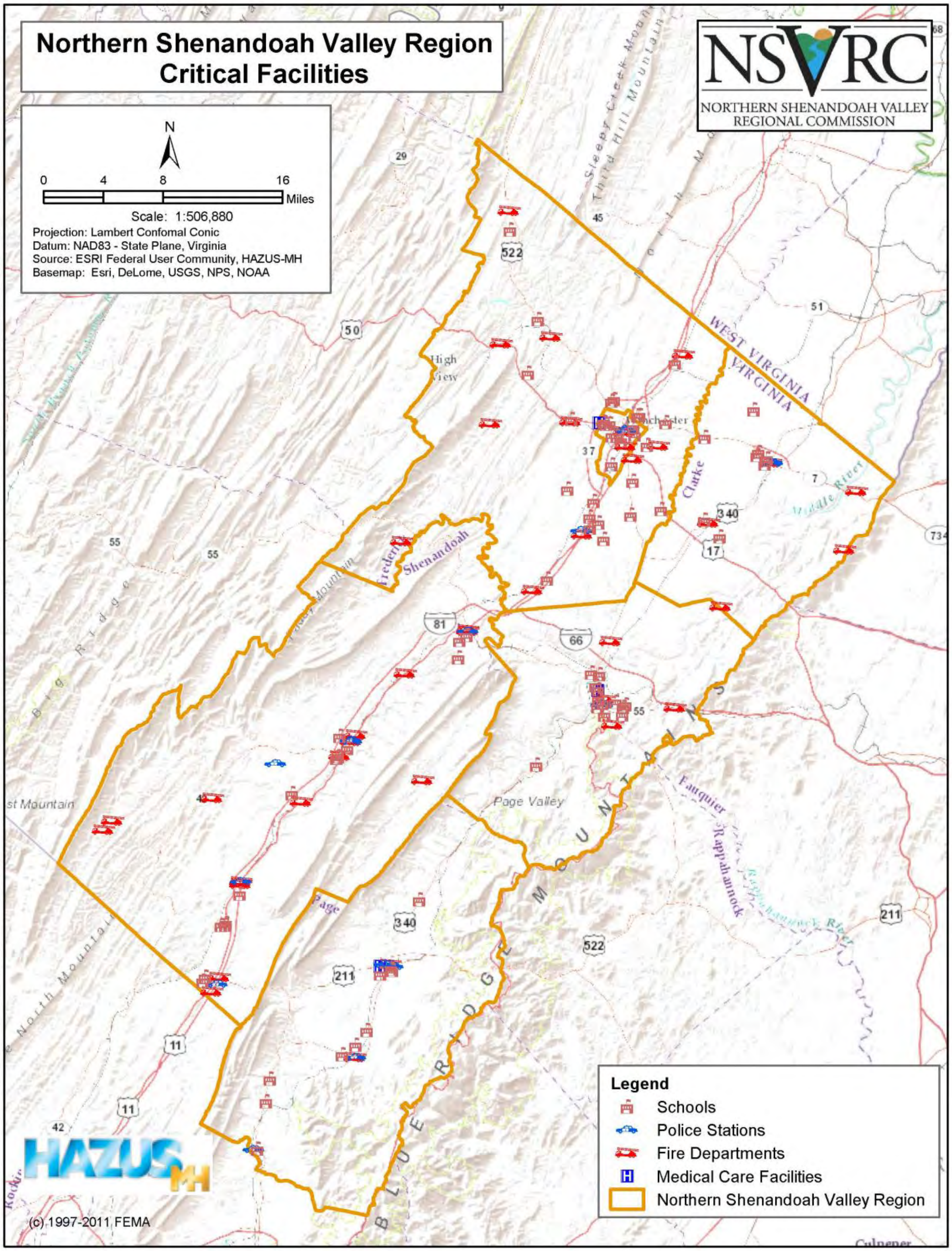


Figure 3.8 – HAZUS-MH Critical Facility Inventory – Source: ESRI, FEMA (HAZUS-MH), USGS, NOAA, NPS

According to FEMA State and Local Plan Interim Criteria, a critical facility is defined as a facility, in either the public or private sector, that provides essential products and services to the general public, is otherwise necessary to preserve the welfare and quality of life in the jurisdiction, or fulfills important public safety, emergency response, and/or disaster recovery functions.

Critical facilities for the NSVRC were derived from a variety of sources. Information provided by the Northern Shenandoah Valley Regional Commission was supplemented with ESRI data as well as geocoded facilities completed by the Virginia Tech Center for Geospatial Information Technology (CGIT). Critical facilities include fire/rescue stations, police stations, government/administrative centers, schools, and churches. Figure V-3 shows the locations of critical facilities in the region. A large percentage of the region's critical facilities are located within town and city boundaries, since most of the population lives within or in close proximity to the region's towns and the City of Winchester.

Analysis for the region was completed using the best available data. Census blocks were used to assess the area's vulnerability to specific hazards such as winter storm and wind. The flooding analysis was conducted primarily using floodplain, tax parcel and building footprint data provided by the communities and NSVRC. For some communities, structure points were determined using Virginia Base Mapping imagery, which was then intersected with the floodplain data for the region. Structure value was established using average house value in the 2010 Census data. The 2010 Census data for average structure value per block was used as a replacement cost in the event of a disaster. This value can serve as a guide in assessing the impacts of various hazards.

Medical

Winchester Medical Center (WMC) serves the Virginia, West Virginia, and Maryland tristate area providing complete health care. The WMC is owned and operated by the Valley Health System. The WMC features their Heart Center, which was ranked as one of the Top 100 in the nation, a Cancer Center, and an Inpatient/Outpatient Rehab Center.

Warren Memorial Hospital located in Front Royal, Virginia is a sister hospital to WMC as they both are owned and operated by Valley Health System. Warren Memorial offers a Women's Care Center and a 40 bed Nursing Home as part of the hospital's facilities.

Shenandoah Memorial Hospital located in Woodstock, Virginia, provides primary health care to Shenandoah County and is owned and operated by Valley Health System. Shenandoah Memorial Hospital features their Family Centered Maternity Ward, Intensive/ Coronary Care Unit and Ambulatory Surgery.

Page Memorial Hospital is located in Luray, Virginia and provides primary health care to the immediate surrounding area of Page County. It should be noted that this facility was not included in the HAZUS-MH database, therefore unrecognized during analysis.

VA Medical Center in Martinsburg, West Virginia provides quality medical care to veterans in the Northern Shenandoah Valley. An Outpatient clinic is now available in Stephens City on Aylor Rd. Emergency airlift is available by Pegasus to the University of Virginia Medical Center and by medivac to INOVA Medical Center.

Police/Fire & Rescue

As inventoried under the Critical Facilities database via HAZUS-MH, it was recognized that the NSV Region is home to 18 various police and sheriffs offices. The region is also home to 35 Fire-Rescue Stations. These facilities and their addresses are listed in tables 3.22 and 3.23.

Table 3.22 - Northern Shenandoah Valley Region Police Departments

Name	Address	City
Clarke County Sheriff's Office	100 N Church St	Berryville
Berryville Police Dept	23 E Main St	Berryville
Stephens Police Dept	1033 Locust St	Stephens City
Luray Town Police	45 E Main St	Luray
Page County Crime Solvers Inc	108 S Court St	Luray
Luray Police Dept	Luray Recreation Park	Luray
Stanley Town Police	278 E Main St # B	Stanley
Shenandoah Police Dept	426 1st St	Shenandoah
Strasburg Police Dept	174 E King St	Strasburg
Edinburg Police Dept	101 Town Hall Rd	Edinburg
County Sheriff	109 W Court St	Woodstock
Woodstock Police Dept	134 N Muhlenberg St	Woodstock
Mt Jackson Police Dept	5945 Main St	Mt Jackson
New Market Police Dept	9418 John Sevier Rd	New Market
Front Royal Police Dept	23 E Jackson St	Front Royal
Warren County Sheriff's Dept	200 Skyline Vista Dr	Front Royal
Frederick County Sherriff's Office	1080 Coverstone Dr	Winchester
Winchester Police Dept	231 E Piccadilly St	Winchester
Winchester City Sheriff	5 N Kent St	Winchester

Table 3.22 - Northern Shenandoah Valley Region Police Departments – Source: HAZUS-MH, Local Police

Table 3.23 - Northern Shenandoah Valley Region Fire/Rescue Stations		
Clarke County		
Name	**Address**	**City**
John H. Enders Volunteer Fire Department	9 S Buckmarsh St.	Berryville
Boyce Volunteer Fire Company	1 S Greenway Ave.	Boyce
Blue Ridge Volunteer Fire and Rescue Company	131 Retreat Rd.	Bluemont
Mount Weather Fire & Rescue	19844 Blue Ridge Mountain Rd.	Bluemont
Frederick County		
Name	**Address**	**City**
Clear Brook Volunteer Fire and Rescue	1256 Brucetown Rd.	Clear Brook
Gainesboro Volunteer Fire and Rescue Company	221 Gainesboro Rd.	Winchester
Reynolds Store Volunteer Fire and Rescue	9381 North Frederick Pk.	Winchester
North Mountain Volunteer Fire and Rescue	186 Rosenberger Ln.	Winchester
Gore Volunteer Fire and Rescue	7184 Northwestern Pk.	Gore
Round Hill Community Fire and Rescue	150 Corporate Pl.	Winchester
Stephens City Volunteer Fire and Rescue	5346 Mulberry St.	Stephens City
Middletown Volunteer Fire and Rescue	7855 Main St.	Middletown
Millwood Station Volunteer Fire and Rescue	250 Costello Dr.	Winchester
Greenwood Volunteer Fire and Rescue	809 Greenwood Rd.	Winchester
Star Tannery Volunteer Fire and Rescue	950 Brill Rd.	Star Tannery
Page County		
Name	**Address**	**City**
Luray Volunteer Fire Department	1 Firehouse Ln.	Luray
Stanley Volunteer Fire Department	190 E Main St.	Stanley
Shenandoah County		
Name	**Address**	**City**
Strasburg Fire Department	163 E King St.	Strasburg
Strasburg Volunteer Rescue Squad	156 E Washington St	Strasburg
Orkney Springs Volunteer Fire Department	922 Orkney Gr.	Bayse
Toms Brook Volunteer Fire Dept.	3442 S Main St	Toms Brook
Fort Valley Volunteer Fire Department	7088 Fort Valley Rd.	Fort Valley
Woodstock Volunteer Rescue Squad	132 W Reservoir Rd.	Woodstock
Woodstock Fire Department	121 W Court St.	Woodstock
Edinburg Volunteer Fire Company	200 Stoney Creek Blvd.	Edinburg
Shenandoah County Department of Fire-Rescue	600 N Main St.	Woodstock
Conicville Volunteer Fire Department	763 Conicville Rd	Mt Jackson
Mount Jackson Volunteer Fire Department	6044 Main St.	Mt Jackson
New Market Volunteer Fire Company Inc.	9771 Congress St.	New Market

Table 3.23 - Northern Shenandoah Valley Region Fire/Rescue Stations (continued)		
Warren County		
Name	**Address**	**City**
Warren County Department of Fire and Rescue	200 Skyline Vista Dr.	Front Royal
Front Royal Volunteer Fire and Rescue Department	221 N Commerce Ave.	Front Royal
Conservation & Research Center Fire Brigade	1500 Remount Rd.	Front Royal
Warren County Station #6	6363 Howellsville Rd.	Front Royal
City of Winchester		
Name	**Address**	**City**
Winchester Fire & Rescue	231 E Piccadilly St.	Winchester

Table 3.23 - Northern Shenandoah Valley Region Fire Stations – Source: HAZUS-MH, Local Fire/EMS

Educational Facilities

There are 77 schools recognized and recorded in the HAZUS U.S. Census derived ‘Essential Facilities’ database. The majority of these schools are located in the largest of the NSVR jurisdictions, Frederick County. During school hours, Fredrick County can possess over 14,000 students. The NSVR Region as a whole can see over 37,000 students during a school day. Table 3.24 depicts the inventory of schools throughout the NSV Region, their location and the number of students enrolled.

Table 3.24 - Northern Shenandoah Valley Region Schools Inventory		
Clarke County		
Name	**Address**	**Approximate Number of Students**
Public Schools		
Boyce Elementary School	119 W Main St, Boyce, VA	284
Clarke County High School	627 Mosby Blvd, Berryville, VA	674
D.G. Cooley Elementary	34 Westwood Rd, Berryville	548
Johnson-Williams Middle School	200 Swan Ave, Berryville	472
Private Schools		
Grafton School	John Mosby Hwy, Berryville	41
Keystone Christian Academy	15 Keystone Ln, Berryville	73
Powhatan School	49 Powhatan Ln, Boyce	243
Clarke Total		**2,335**
Frederick County		
Name	**Address**	**Approximate Number of Students**
Public Schools		
Admiral Richard E. Byrd Middle	134 Rosa Ln, Winchester	942
Apple Pie Ridge Elementary	349 Apple Pie Ridge Rd, Winchester	455
Armel Elementary	2239 Front Royal Pike, Winchester	644
Bass-Hoover Elementary	471 Aylor Rd, Stephens City	631
Evendale Elementary	220 Rosa Ln, Winchester	521
Frederick County Middle	4661 North Frederick Pike, Winchester	685
Gainesboro Elementary	4651 N Frederick Pike, Winchester	472
Greenwood Mill Elementary	281 Channing Dr, Winchester	618
Indian Hollow Elementary	1548 North Hayfield Rd, Winchester	433
James Wood High	161 Apple Pie Ridge Rd, Winchester	1,316
James Wood Middle	1313 Amherst St, Winchester	948
Middletown Elementary	190 Mustang Ln, Middletown	479
Millbrook High	251 First Woods Dr, Winchester	1,450
Orchard View Elementary	4275 Middle Rd, Winchester	460
Redbud Run Elementary	250 First Woods Dr, Winchester	693
Robert E. Aylor Middle	901 Aylor Rd, Stephens City	626
Sherando High	185 South Warrior Dr, Stephens City	1,511
Stonewall Elementary	3165 Martinsburg Pike, Clear Brook	641

Table 3.24 - Northern Shenandoah Valley Region Schools Inventory (continued)

Name	Address	Approximate Number of Students
Frederick County		
Private Schools		
Mountain View Christian Academy	153 Narrow Ln, Winchester	246
Shenandoah Valley Christian Academy	4699 Valley Pike, Stephens City	41
Winchester Montessori School	1090 W Parkins Mill Rd, Winchester	32
Timber Ridge School	1463 New Hope Rd, Cross Junction	84
Rosedale Christian Academy	2581 Northwestern Pike, Winchester	221
Frederick Total		**14,149**
Page County		
Name	**Address**	**Approximate Number of Students**
Public Schools		
Luray Elementary	555 First St, Luray	435
Luray High	243 Bulldog Dr, Luray	522
Luray Middle	14 Luray Ave, Luray	371
Page County High	184 Panther Dr, Shenandoah	553
Page County Middle	198 Panther Dr, Shenandoah	454
Shenandoah Elementary	529 4th St, Shenandoah	332
Springfield Elementary	158 Big Spring Ln, Rileyville	256
Stanley Elementary	306 Aylor Grubbs Ave, Stanley	426
Private Schools		
Stanley S D A School	118 Church Ave, Stanley	26
Mt. Carmel Christian Acamey	Rt. 340, Luray	112
Page Total		**3,504**
Shenandoah County		
Name	**Address**	**Approximate Number of Students**
Public Schools		
Ashby Lee Elementary	480 Stonewall Ln, Quicksburg	794
Central High	1147 Susan Ave, Woodstock	799
North Fork Middle	1018 Caverns Rd, Quicksburg	339
Peter Muhlenberg Middle	1251 Susan Ave, Woodstock	549
Sandy Hook Elementary	162 Stickley Loop, Strasburg	904

Table 3.24 - Northern Shenandoah Valley Region Schools Inventory (continued)		
Shenandoah County		
Name	**Address**	**Approximate Number of Students**
Public Schools (continued)		
Signal Knob Middle	687 Sandy Hook Rd, Strasburg	444
Stonewall Jackson High	150 Stonewall Ln, Quicksburg	510
Strasburg High	250 Ram Dr, Strasburg	606
W.W. Robinson Elementary	1231 Susan Ave, Woodstock	1,118
Private Schools		
Valley Baptist Christian School	408 Stoney Creek Rd, Edinburg	104
Massanutten Military Academy	614 S Main St, Woodstock	141
Shenandoah Valley Adventist Elementary	115 Bindery Rd, New Market	103
Shenandoah Valley Academy	234 W Lee Hwy, New Market	235
Community Christian School	23749 Old Valley Pike, Woodstock	39
Shenandoah Total		**6,685**
Warren County		
Name	**Address**	**Approximate Number of Students**
Public Schools		
A.S. Rhodes Elementary	224 W Strasburg Rd, Front Royal	279
E. Wilson Morrison Elementary	40 Crescent St, Front Royal	545
Hilda J. Barbour Elementary	290 Westminster Dr,Front Royal	504
Leslie Fox Keyser Elementary	1015 Stonewall Dr, Front Royal	558
Ressie Jeffries Elementary	320 East Criser Rd, Front Royal	557
Skyline High	151 Skyline Vista Dr, Front Royal	888
Skyline Middle School	240 Luray Ave, Front Royal	650
Warren County High	155 Westminster Dr, Front Royal	821
Warren County Middle School	522 Heritage Dr, Front Royal	593
Private Schools		
Riverfront Christian School	55 E Strasburg Rd, Front Royal	124
Mountain laurel Montessori School	155 Briggs Dr, Front Royal	68
Randolph-Macon Academy	200 Academy Dr, Front Royal	288
Academy at Innsfree	366 Thuinderbird Dr, Front Royal	24
Royal Christian Academy	1111 N Shenandoah Dr, Front Royal	133
Warren Total		**6,032**

Table 3.24 - Northern Shenandoah Valley Region Schools Inventory (continued)		
City of Winchester		
Name	**Address**	**Approximate Number of Students**
Public Schools		
Daniel Morgan Intermediate School	48 S. Purcell St, Winchester	672
Daniel Morgan Middle School	48 S Purcell Ave, Winchester	632
Frederick Douglass Elementary	100 Cedarmeade Ave, Winchester	330
Garland R. Quarles Elementary	1310 S Loudoun St, Winchester	429
John Handley High School	425 Handley Blvd, Winchester	1,313
John Kerr Elementary	427 Meadow Branch Ave, Winchester	557
Virginia Avenue Charlotte Dehart Elementary	550 Virginia Ave, Winchester	452
Private Schools		
Sacred Heart Academy	110 Keating Dr, Winchester	177
Winchester Total		**4,562**

Table 3.24 - Northern Shenandoah Valley Region Schools Inventory – Source: VA Dept. of Education - School Quality Reports 2018

Religious Institutions - (Churches, Synagogues, Mosques, Etc.)

Outside of hours of regular worship, most religious institutions use their places of worship as community meeting centers, day care facilities, or even schools. Information collected from the ESRI Federal User Community, attributes the NSV Region with approximately 336 religious establishments, as seen in Figure 3.10.

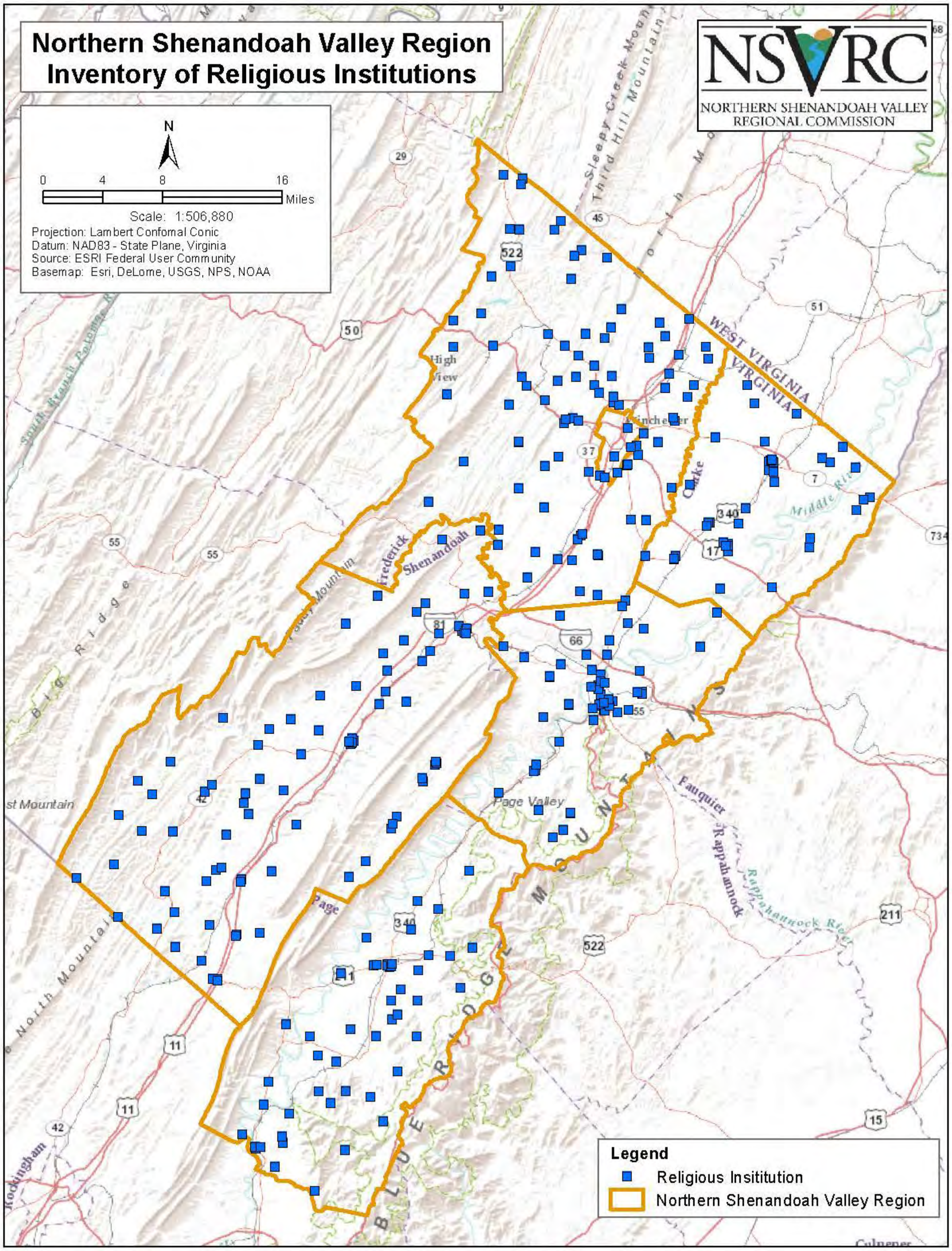


Figure 3.10 – Northern Shenandoah Valley Region Religious Institutions – Source: ESRI Federal User Community, USGS, NOAA, NPS

Transportation

Highways, Interstates, Major Roads

Two major U.S. Interstates intersect the Northern Shenandoah Valley Region. Interstate 81 operates North/South through the western portions of Frederick and Shenandoah Counties, while Interstate 66 enters Warren County from the East, connecting with Interstate 81 near the Frederick/Shenandoah County borders. Several notable arterial highways provide access to these interstates. U.S. 11 runs parallel to Interstate 81, operating North/South throughout the entire length of region. U.S. 522 proceeds diagonally through Frederick County, enters Clarke at its SW corner, and then connects with U.S. 340 North/South in Warren County. U.S. 50 operates East/West through Frederick County and intersects with U.S. 17 in Clarke. Skyline Drive (State Route 48) is a scenic highway that runs along the Eastern border of Warren and Page Counties, attracting a continuous flow of tourists annually.

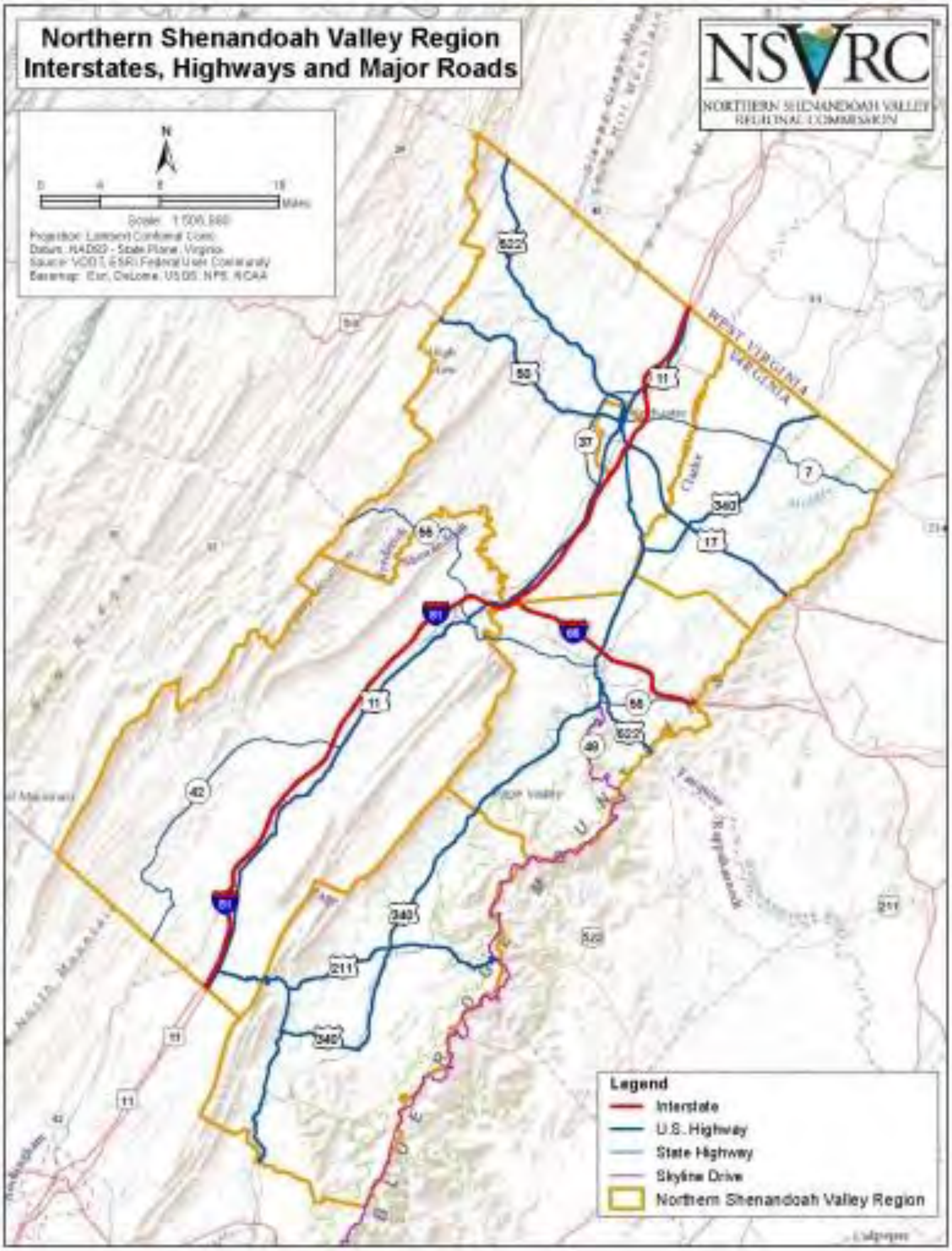


Figure 3.11 – Northern Shenandoah Valley Region Interstates, Highways and Major Roads – Source: ESRI, USGS, NOAA, NPS, VDOT

Railroads

Nearly 230 miles of rail are established within the Northern Shenandoah Valley Region. The two primary railroads operating in the region are CSX and Norfolk Southern lines. Norfolk Southern has lines running through Clarke, Frederick, Warren, Page and Shenandoah Counties. The CSX rail lines run mainly through Frederick County. Conrail Railroad serves as a shared asset of CSX Railroad and Norfolk Southern Railroad, with its tracks located North of Winchester. The Winchester and Western Railroad connects to the Conrail line, operating through Winchester into the western portions of Frederick County.

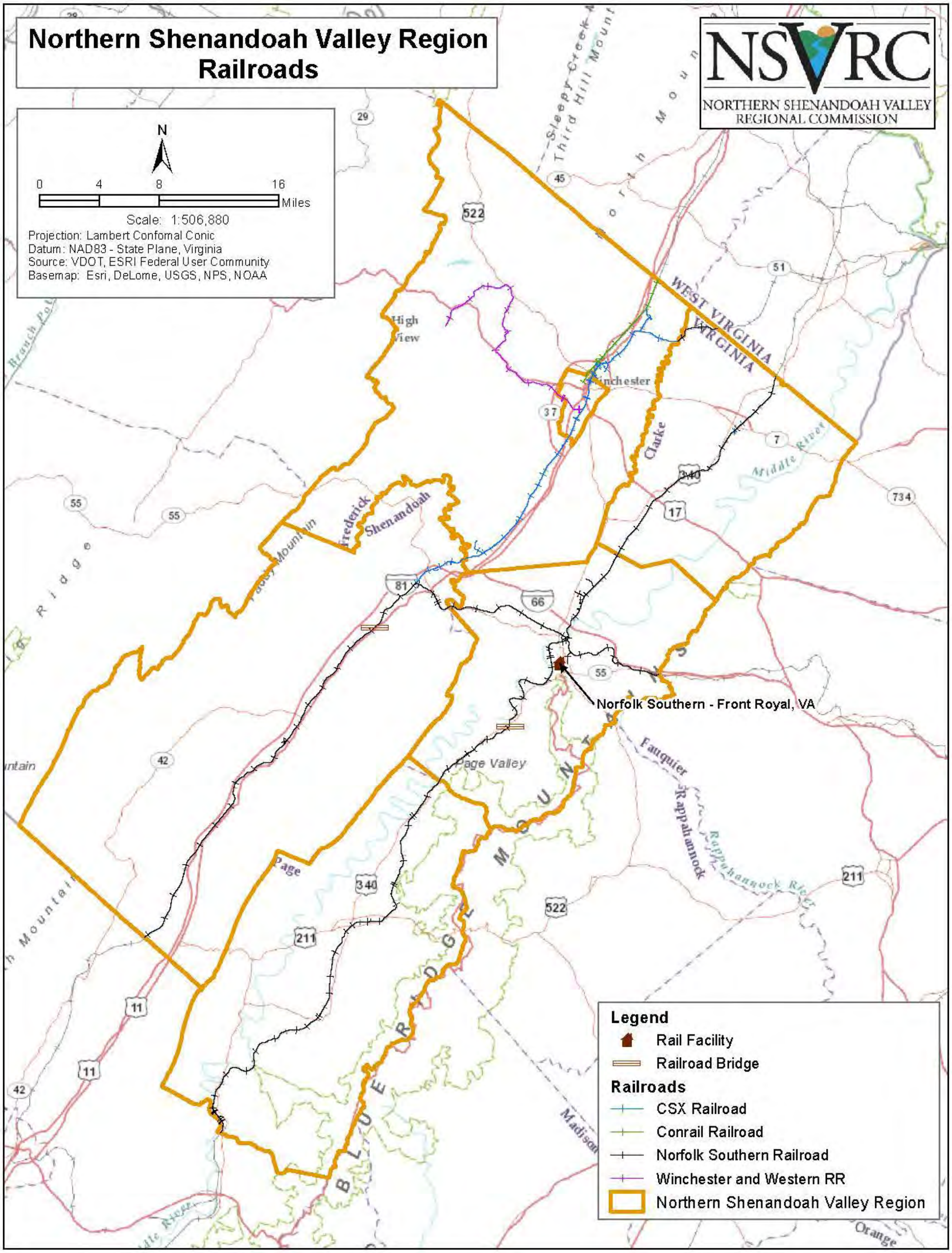


Figure 3.11 – Northern Shenandoah Valley Region Railroads - Source: ESRI, USGS, NOAA, NPS, VDOT

Airports

There are 4 airports local to the Northern Shenandoah Valley Region: Front Royal-Warren County Airport, Luray Caverns Airport, New Market Airport and Winchester Regional Airport. Of these local facilities, Winchester Regional is the only to offer a customs service, parallel taxiways and an airport terminal. The nearest international airports are located in Dulles, VA, (Washington/Dulles International Airport), Washington, D.C. (Ronald Regan International Airport) and Baltimore, MD (Baltimore/Washington International – Thurgood Marshall Airport).

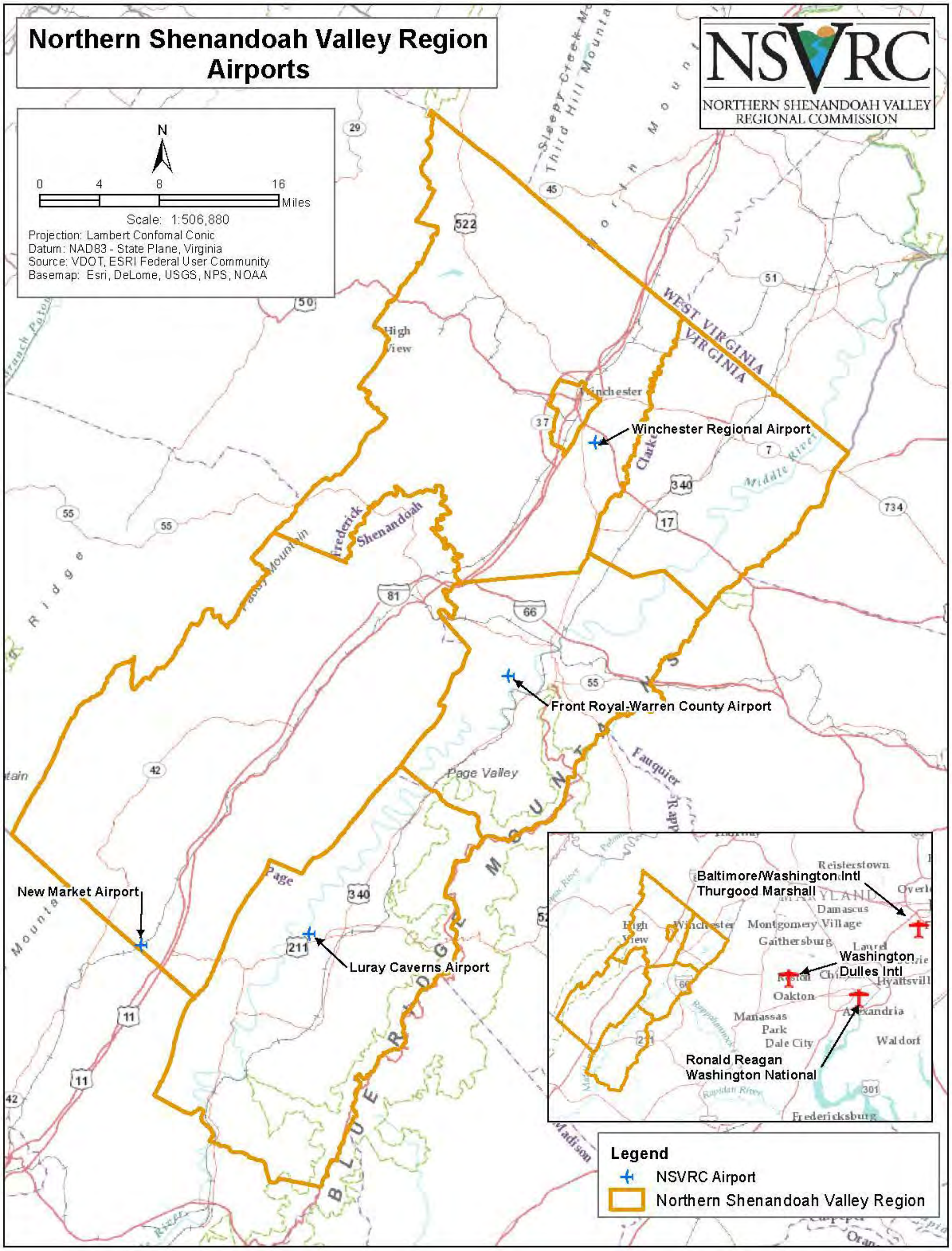


Figure 3.11 – Northern Shenandoah Valley Region Airports - Source: ESRI, USGS, NOAA, NPS, VDOT

Public Transportation

The City of Winchester and Front Royal operate a bus/trolley service throughout their communities.

Winchester's fixed-route and para-transit services operate 6 days a week Monday- Friday 6:00 a.m. – 7:58 p. m., and on Saturday 8:50 a.m. – 4:58 p.m. The Winchester City Trolley operate Monday/Wednesday/Friday 8:00 a.m. – 6:44 p.m., and on Saturdays 10:10 a.m. – 4:34 p.m.

Front Royal manages both a North and South trolley service loop. The North loop runs from 8:30 a.m. – 4:00 p.m., while the South loop runs from 9:00 a.m. – 4:30 p.m. Saturday service is active during the months of May and June, operating from 1:00 p.m. to 5:30 p.m. and Sunday operates between 1:00 p.m. – 6:00 p.m.

Bus Terminals

The Virginia Breeze bus service connects the Northern Shenandoah Valley to cities along Interstate 81 and 66, with serval stops in the New River Valley, Shenandoah Valley and Northern Virginia.

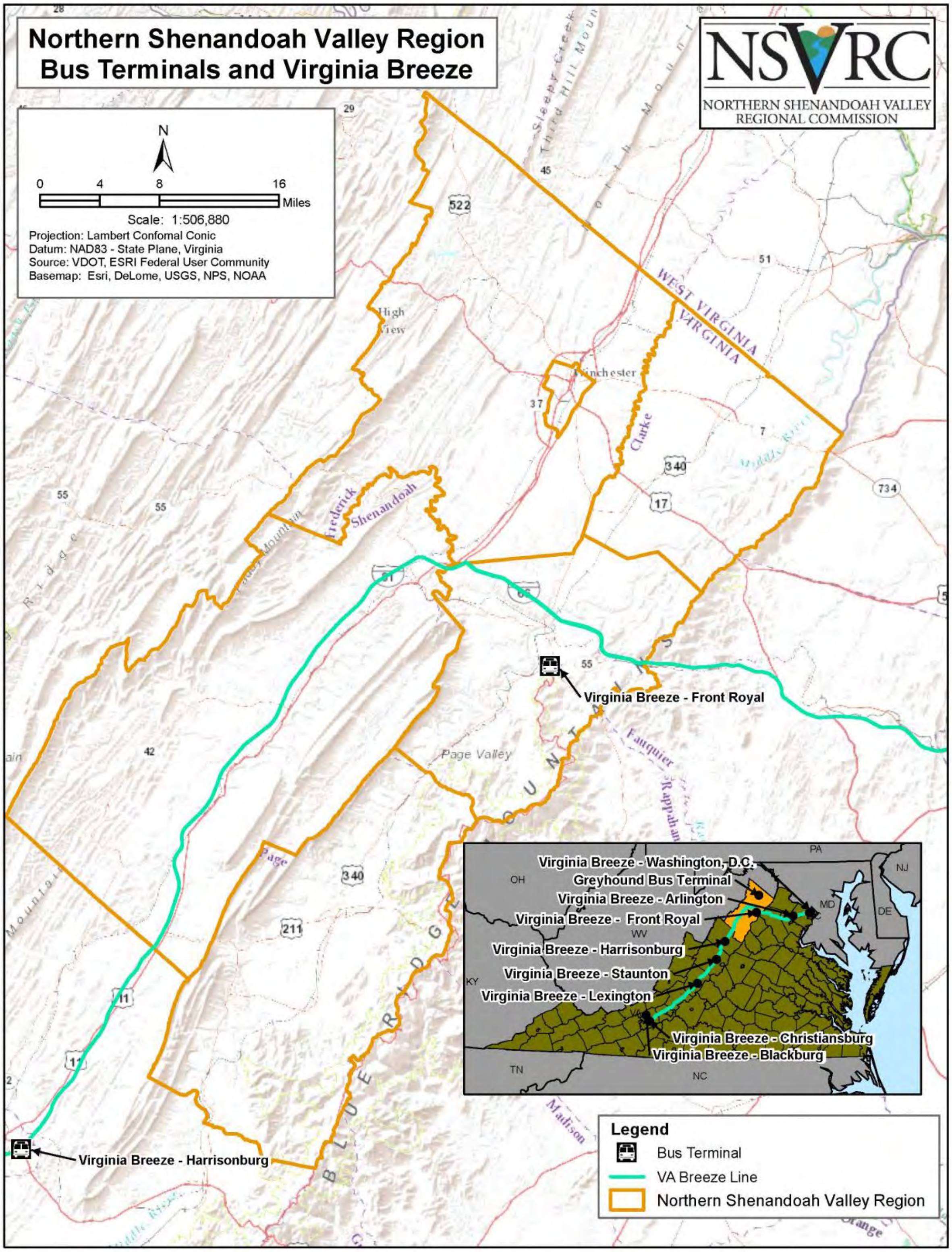


Figure 3.12 – NSV Bus Terminals and VA Breeze Route - Source: ESRI, USGS, NOAA, NPS, VDOT

Virginia Inland Port

The Virginia Port Authority manages 6 cargo terminals throughout the state of Virginia. These port facilities generate nearly $17.5 billion in annual compensation, contribute $1.4 million in state and local taxes, and are responsible for nearly 10% of the state's resident workforce (William & Mary).

Front Royal is home to the VA Port Authority's Virginia Inland Port. The Virginia Inland Port offers wheeled storage, grounded storage, and general open storage. There are currently 19 acres available here for lease. It has direct access to Interstates 81 and 66, and is home to 17,280 linear feet of railroad tracks.

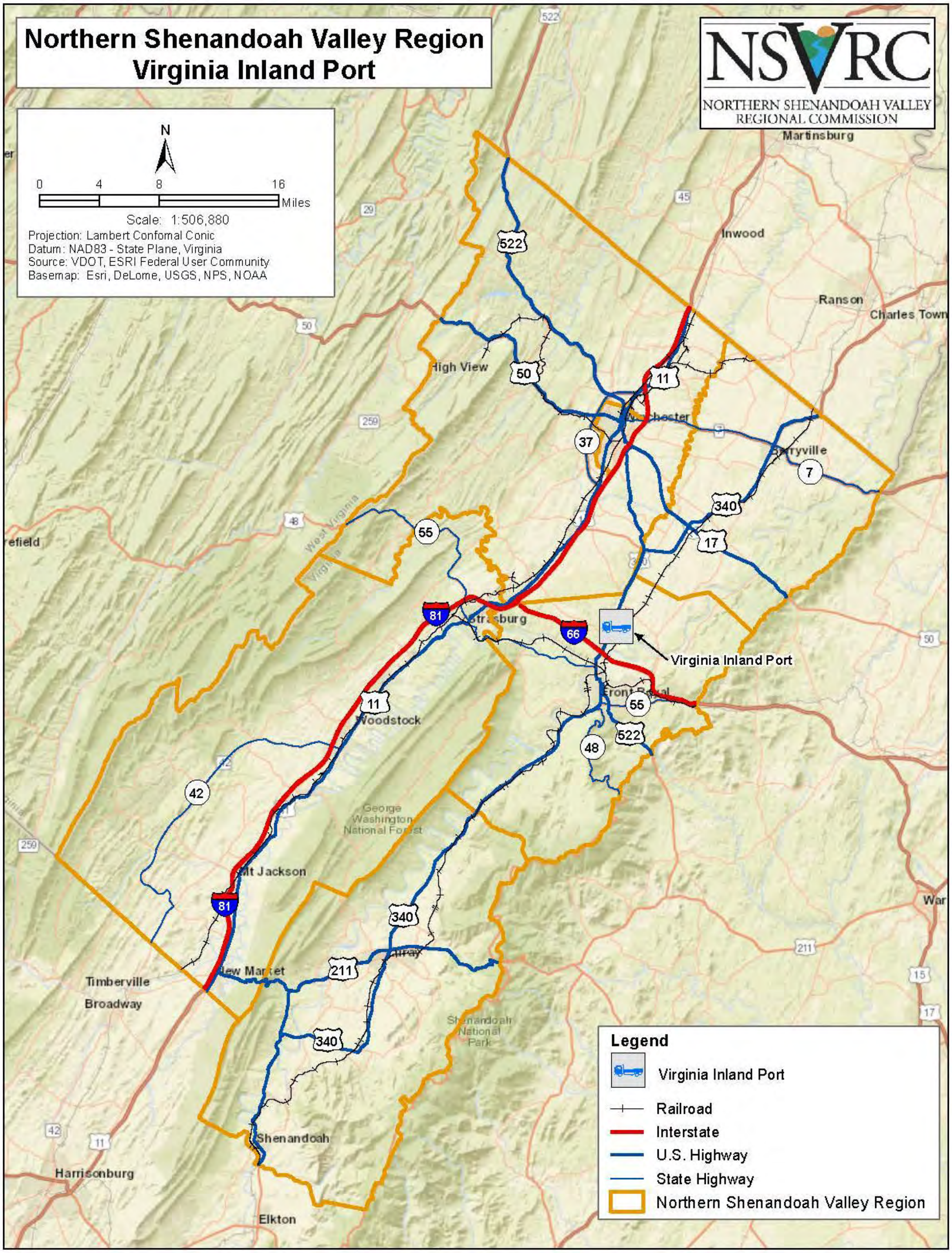


Figure 3.13 – Virginia Inland Port - Source: ESRI, USGS, NOAA, NPS, VDOT

Utilities and Services

Call Miss Utility at **811** before you dig, to have utilities marked and located.

In cases of gas leak or other emergency, call **911**.

Electricity

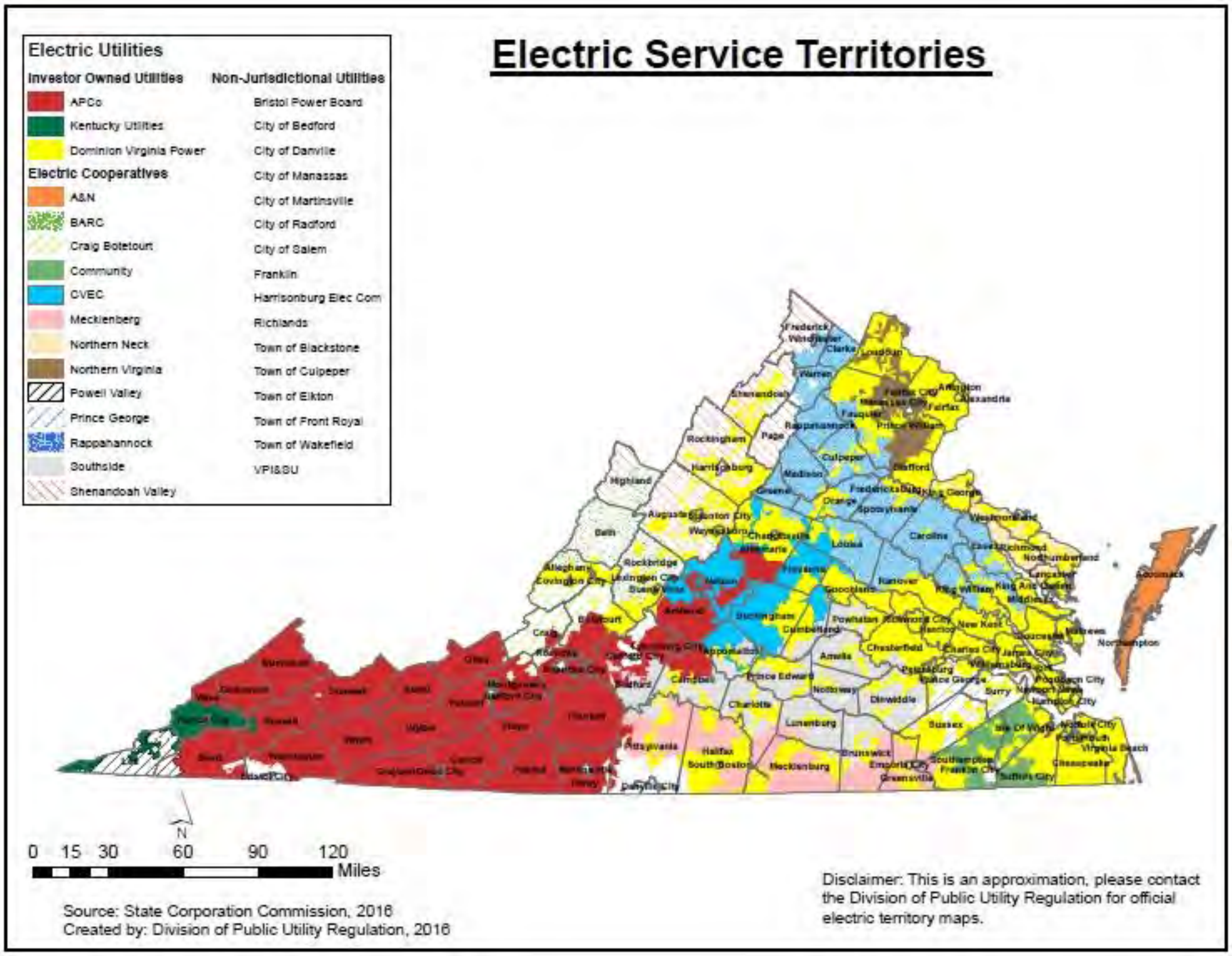


Figure 3.14 – Virginia Electric Service Territories – Source: State Corporation Commission

NSV Region Investor Owned Utilities:

- **Dominion Power**
  - **Report/Check Outages:**
    - (866) 366-4357
    - https://www.dominionenergy.com/outage-center

NSV Region Electric Cooperatives:

- **Shenandoah Valley Electric Cooperative**
    - **Mt. Jackson Office** (540) 477-1077
    - **Luray Office** Page: (540) 743-1100 Warren: (540) 635-1110
    - **Winchester Office (**540) 450-0111
  - **Report Check Outages:**
    - https://www.outageentry.com/CustomerFacingAppJQM/outage.php?clientid=SVEC
- **Rappahannock Electric Cooperative**
    - **Blue Ridge Office** (540) 622-2001 OR (800) 552-3904
  - Report Check Outages:
    - http://www.myrec.coop/outagecenter/index.cfmNatural Gas Suppliers

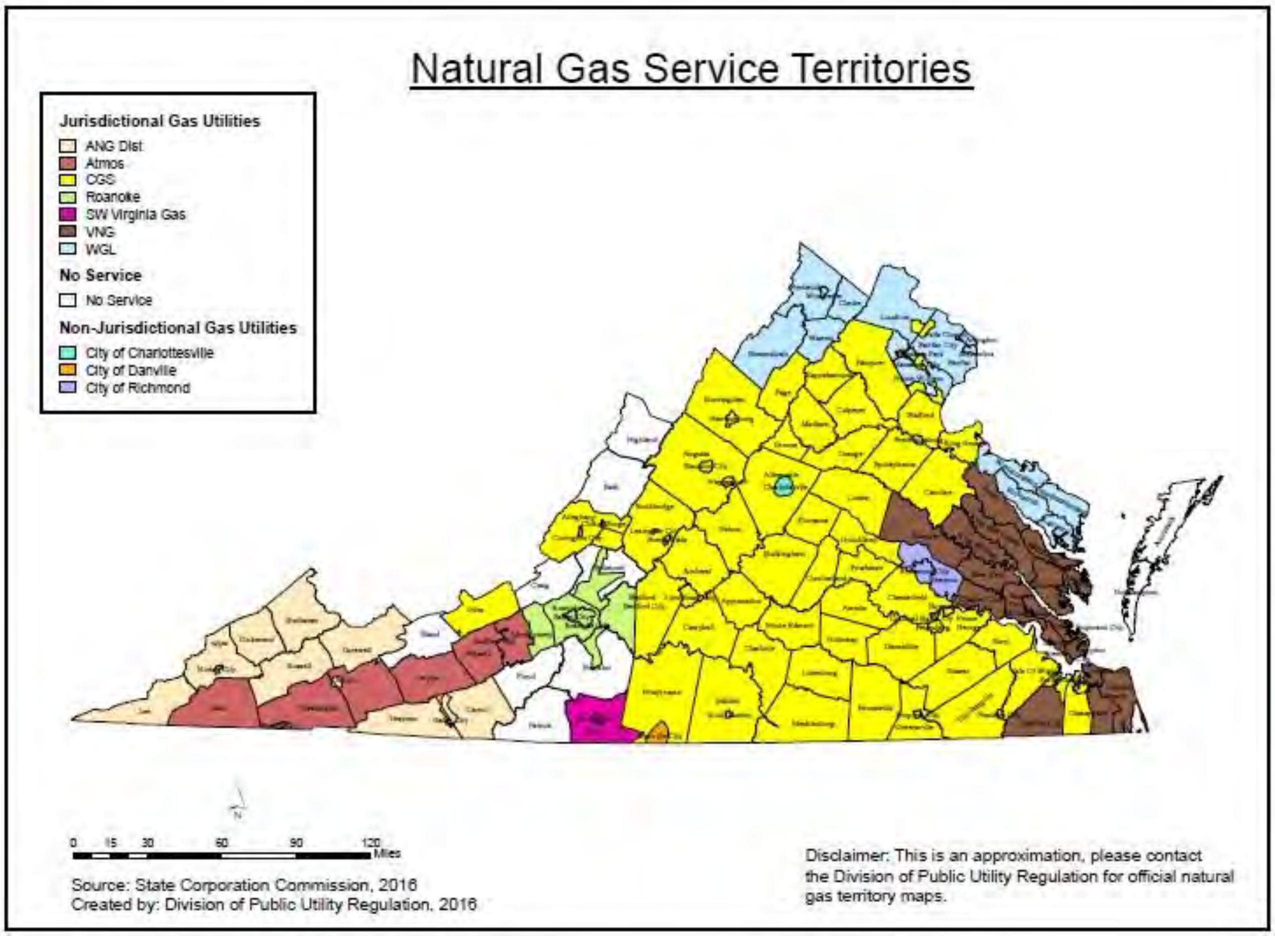


Figure 3.15 – Virginia Natural Gas Service Territories - Source: State Corporation Commission

- NSV Region Suppliers – In case of gas leak or other emergency **CALL 911**
  - Trans Canada (Acquired Columbia Gas Transmission Corporation Pipeline in 2016)
    - Emergency Response Line - 1.800.835.7191
  - Shenandoah Gas Company (Division of Washington Gas Light)
    - Emergency Response Line - (703) 750-1400 or (800) 752-7520

Public Utilities

Northern Shenandoah Valley Region Water and Sewer Statistics				
Locality	Water		Sewer	
	Max Capacity	Average Daily	Capacity Daily	Percent load
Clarke: Berryville	864,000GPD	406,000GPD	450,000GPD	56%
Boyce/Millwood/White Post	180,000GPD	65,000GPD	None	None
Boyce/Millwood	-	-	50,000	44%
Frederick: Middletown	3,200,000GPD	2,213,000GPD	8,400,000GPD	58%
Stephens City	3,200,000GPD	2,213,000GPD	8,400,000GPD	58%
Page: Luray	1.224,000GPD	854,000GPD	2,400,000GPD	64%
Shenandoah	601,000GPD	246,359GPD	250,00GPD	56%
Stanley	529,600GPD	450,000GPD	300,000GPD	50%
Shenandoah: Bayse	269,000GPD	150,583GPD	600,000GPD	66%
Edinburg	250,000GPD	126,000GPD	175,000GPD	53%
Mt. Jackson	580,000GPD	301,000GPD	200,000GPD	90%
New Market	1,600,000GPD	545,000GPD	500,000GPD	90%
Strasburg	1,140,000GPD	800,000GPD	975,000GPD	82%
Toms Brook/ Maurertown	170,000GPD	95,000GPD	189,796GPD	52%
Woodstock	1,300,000GPD	750,000GPD	1,000,000GPD	55%
Warren: Front Royal	3,000,000GPD	2,131,000GPD	4,000,000GPD	62%
City of Winchester	10,000,000GPD	7,106,000GPD	8,400,000GPD	58%

Table 3.25 – NSVRC Water and Sewer Statistics – Source: 2012 Regional Water Supply Plan

Solid Waste Disposal

- Frederick Co. Sanitary Landfill (540 Acres) [also serves City of Winchester and Clarke Co.]
- Shenandoah Co. Sanitary Landfill (214 Acres)
- Warren Co. Waste Transfer Station (8 Acres)
- Page Co. Landfill (160 Acres)

Liquid Petroleum (Propane, Butane) Gas Distributors

NSV LP Gas Distributors: Call Miss Utility at 811 before you dig

In case of gas leak or related emergency call 911

- Amerigas-Shengas Division - (800) 237-1320
- Blossman Gas - (540) 955-4677
- Columbia Gas of Virginia – (800) 544-5606
- Holtzman Propane - (540) 465-9200
- Quarles Petroleum, Inc. – (540) 371 - 2400
- Roberts Oxygen Co. Inc. - (540) 662-1180
- Southern States – Winchester (540) 662-0375, Stephens City (540) 869-3132
- Tri-State Propane - (800) 237-1320
- Valley Gas Corp. - (540) 778-3216

Fuel Oil Distributors

- Bauserman Oil
- Clarke Co. Supply
- E.N. Hershberger Co.
- Emmart's Luray Gas & Oil Co.
- Glover John D. & Sons
- H.N. Funkhouser & Co.
- Holtzman Oil Corp.
- Mercer Oil & Coal Co.
- Mowery Oil Co.
- Quarles Petroleum
- Shenandoah Valley Oil Co.
- Southern States
- Valley Discount Fuel Oil

Coal Services

- Al Shirley & Sons, Inc.
- Henry's Coal Yard; Mercer Oil &Coal Co.
- Orndorff's Coal Yard
- Vehrencamps

Communications

Telephone Service

- Local: Adelphia, Intelos, Sprint, Shenandoah Telecommunications Co., Verizon
- Long Distance: Equal Access for all of Region

Internet Providers

- Comcast (XFINITY)
- Verizon (FIOS)
- Visual Link LLC
- AT&T Internet Service
- Winchester Wireless
- Local net
- Blue Dog Internet
- Wave2Net
- The Wireless Center
- Shenandoah Telecommunication Company
- Direct TV

Newspapers

- Daily (State and Local)
- Northern Virginia Daily, (Strasburg)
- The Richmond Times Dispatch, (Richmond)
- The Washington Post, (Washington, DC)
- The Winchester Star, (Winchester)
- Weekly (Local)
- Page News and Courier, (Luray)
- Shenandoah Valley Herald, (Woodstock)
- The Warren Sentinel, (Front Royal)
- The Free Press, (Woodstock)
- Monthly (Regional)
- Quad State Business Journal, (Winchester)

Radio Stations:

- 91.3 WTRM (FM), Winchester
- 92.5 WINC (FM), Winchester
- 93.7 WAZR (FM), Woodstock
- 95.3 WFTR (FM), 1450 AM, Front Royal
- 96.9 WISG (FM), 790 (AM), Mt. Jackson
- 99.3 WFQX (FM), Strasburg
- 102.5 WUSQ (FM), 610 (AM), Winchester
- 103.3 WEZI (FM), Harrisonburg
- 104.9 WAPP (FM). Berryville
- 105.1 WAMM (FM), Woodstock
- 105.5 WBPP (FM), Berryville
- 105.7 WZXI (FM), Luray
- 610 WNTW (AM), Winchester
- 1300 WRAA (AM), Luray

- 1400 WINC (AM), Winchester

Television Stations:

- None based in NSVRC

Cable Television Providers:

- Xfinity - Clarke, Frederick, Page, Warren Counties; City of Winchester
- Shentel - Shenandoah County

Chapter 4: Hazard Identification and Risk Assessment

The HIRA Process

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.]

The localities in the NSV are prone to many natural and manmade hazards. Virginia has experienced thousands of hazard events, resulting in millions of dollars in losses and casualties, and Presidential disaster declarations. To meet the planning requirements of the Disaster Mitigation Act of 2000, a Hazard Identification and Risk Assessment (HIRA) has been developed and included by the localities in this Hazard Mitigation Plan update. This Chapter is formatted as follows to comply with regulations:

1. **Introduction to the HIRA process**
2. **Declared Disasters (as updated from 2012 Plan)**
3. **Hazard Inventory**
4. **Hazard Rankings Process and Results**
    a. **Hazard Identification Risk Analysis (HIRA) Critical Facilities and vulnerability**

HIRA is a systematic way to identify and analyze hazards to determine their scope, impact and the vulnerability of the built environment to such hazards. The purpose of the HIRA is to:

1. **Identify what hazards could affect the NSV**
2. **Profile hazard events and determine what areas and community assets are the most vulnerable to damage from these hazards**
3. **Estimate losses and prioritize the potential risks to the community**

The Hazard Identification and Risk Assessment for the *Commonwealth of Virginia Emergency Operations Plan Support Annex 3 - Enhanced Hazard Mitigation Plan* (by the University of Virginia Polytechnic Institute's Center for Geospatial Information Technology [CGIT]) was reviewed during the 2012 update, and used to identify natural disasters likely to be experienced in the NSV. The 2012 plan was the baseline for this update. Each of the hazards have been re-evaluated to determine their current impact or threat on the area, and used to facilitate the ranking and analysis in this Plan update.

FEMA guidelines emphasize using "best available data" for this plan. Data availability issues were compounded by the lack of standardization and records. Inadequate information about local features such as critical facilities and infrastructure remain in this update and will be evaluated and revised annually during the Plan review process, as new information becomes available.

To the degree data was available, this section will cover identifying hazards, ranking of hazard events, and assessing vulnerability to the NSV Region, estimating potential losses by jurisdiction, assessing vulnerability of critical facilities, and estimating potential losses of such facilities. The facility vulnerability assessment and loss estimation is discussed later in this chapter.

Declared Disasters

Communities in the NSV have received 12 Presidential Disaster Declarations since 1972. Additional major disasters declared since the 2012 Plan include the following. When no community-specific description is available, the general description represents the entire planning area.

Presidential Disasters declared in Virginia since the 2012 Plan:

Source: http://www.fema.gov/disasters

- **Virginia Hurricane Matthew (DR-4291**)
    - Incident period: October 07, 2016 to October 15, 2016
    - Major Disaster Declaration declared on November 02, 2016
- **Virginia Severe Winter Storm And Snowstorm (DR-4262)**
    - Incident period: January 22, 2016 to January 23, 2016
    - Major Disaster Declaration declared on March 07, 2016
- **Virginia Hurricane Sandy (DR-4092)**
    - Incident period: October 26, 2012 to November 08, 2012
    - Major Disaster Declaration declared on November 26, 2012
- **Virginia Hurricane Sandy (EM-3359)**
    - Incident period: October 26, 2012 to November 01, 2012
    - Emergency Declaration declared on October 29, 2012
- **Virginia Severe Storms and Straight-line Winds (DR-4072)**
    - Incident period: June 29, 2012 to July 01, 2012
    - Major Disaster Declaration declared on July 27, 2012

Hazard Inventory and Risk Assessment

Although any type of disaster is possible for any given area in the United States, the most likely hazards that could potentially affect the communities in the Northern Shenandoah Valley Regional Commission, based on past incidence and the knowledge of the Mitigation Advisory Committee, include:

- Flood
- Hurricanes and Coastal Storms
- Severe Thunderstorms
- Tornadoes
- Wildfire
- Drought /Extreme Heat
- Winter Storms
- Ice
- Hail
- Erosion
- Dam Failure
- Earthquakes
- Karst (Sinkholes)
- Landslides

There was public desire to add analysis of manmade or human caused hazards; however, the 2018 steering committee focused first on natural disasters more pertinent to federal funding opportunities associated with hazard mitigation planning.

The mandated hazard identification risk assessment (HIRA) section of this chapter was conducted using various methods based on available data. The HIRA is listed separately for each hazard type and includes an assessment of impacts on critical facilities, estimated losses to facilities, and vulnerability to the hazard based on the history of such hazards. The 2012 Plan served as a baseline for the HIRA and is updated herein. The risk assessment includes a description of the jurisdiction's vulnerability to the hazards identified, including a summary of each hazard and its impact on the community. Unless otherwise stated, each hazard is anticipated to affect the region with the same likelihood of impact and each locality is considered to be equally vulnerable to the natural hazard. Vulnerability includes the following based on availability of data and guidance from the hazard mitigation steering committee:

- The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;
- An estimate of the potential dollar losses to vulnerable structures identified in this section and a description of the methodology used to prepare the estimate.
- An estimate of the likelihood of risk to a locality from a hazard based on the general description of land uses and development trends within the community.

As noted above, if a specific locality's risk varies from that of the region in this multijurisdictional risk assessment, the specific jurisdictional risk is noted. The information for analysis and data used for each of the hazard varies.

Flooding

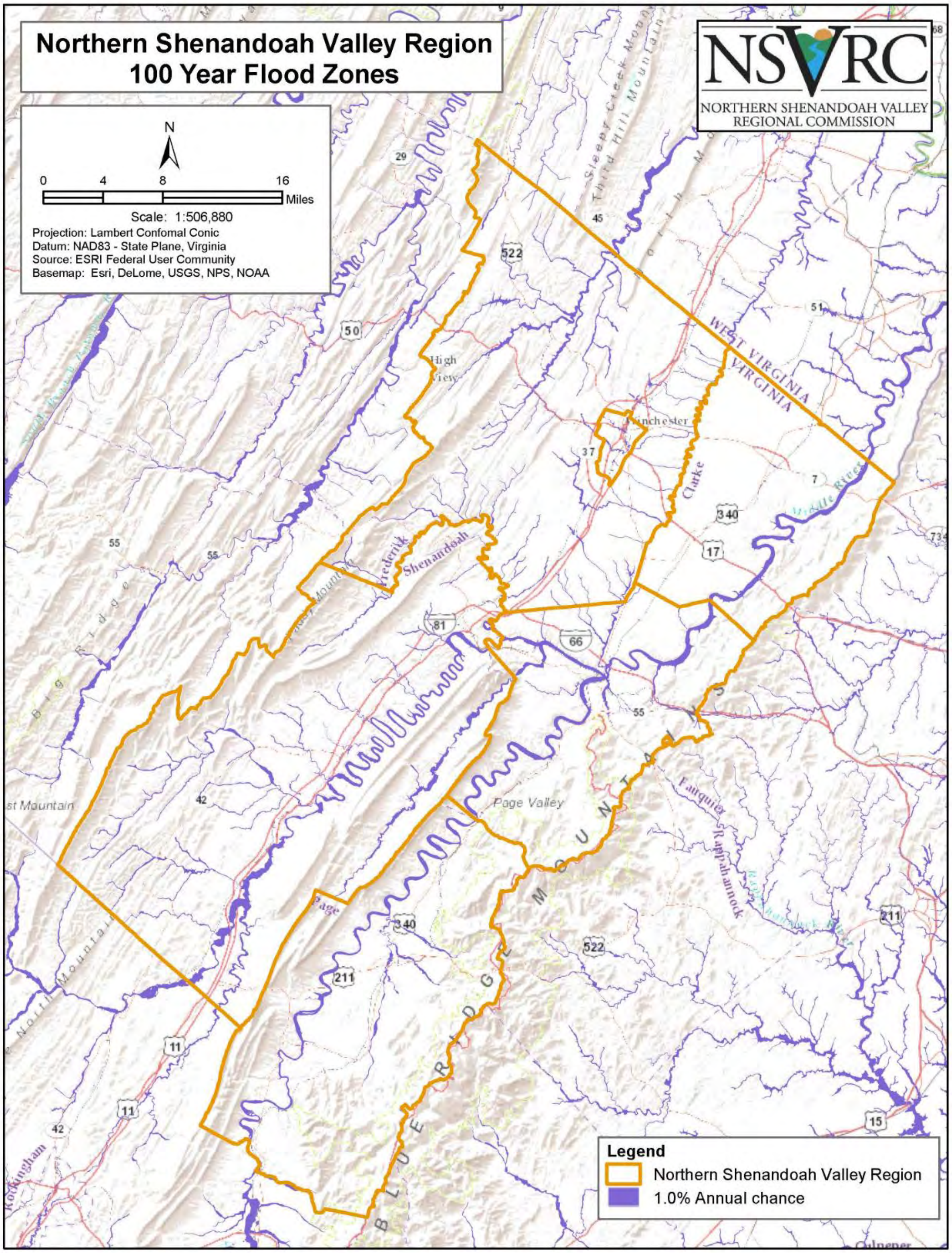


Figure 4.1 – Northern Shenandoah Valley Region 100 year Floodplain

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 are a result of 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. Watersheds for the region are presented in the previous Chapter 3, in Figure 3.5. For the most part, the severity of a flooding event is determined by a combination of the topography of the region, the type and duration of the precipitation event, percent slope, soil type, existing soil moisture, and the extent and type of vegetative cover. According to the Society for Wetland Scientists, vegetation and wetlands in particular are known for abating the severity of a flood event absorbing a wall of water and like a sponge, slowly releasing the water downstream several days or weeks after a flooding event.

Flooding is also likely within wetland areas due to high groundwater tables to the surface. The acres of wetlands are presented below for each County within the region. The wetland types are palustrine freshwater habitats. These were mapped using GIS layers of a National Wetland Inventory available from the U.S. Fish & Wildlife Service as listed below for each locality. Page County has the highest percentage of land in wetlands, with over 11% of the total land area in wetlands. Over 7% of the total land in Warren County is wetlands and more than 3.5% of Clarke County's total land is in wetlands. In Shenandoah County just over 2.6% of the land area is wetland. Less than one percent of the land area in both Frederick County and the City of Winchester is composed of wetlands.

In Virginia, floods usually extend from several days of steady rainfall and can include river, flash, and coastal floods. River floods and flash floods are the most significant and most likely to occur in the NSV Region. Excessive rain and surface water runoff in large quantities result in river flooding. Often flash flooding is initiated with a series of several small storms, or a large event that causes streams to swell due to excessive precipitation and runoff within watersheds. The intense rainfall event exceeds surface absorption capacity and streams spillover their bankfull depth. Flash floods are often associated with slow moving thunderstorms, hurricanes, and tropical storms. The immediate release of water can also occur from an ice jam moved or a breech in a dam or levee. During a flash flood, mountain headwaters and downstream waterways quickly exceed their bankfull depth. This is further exacerbated in urban areas where there are more impervious surfaces resulting in immediate runoff diverted to adjacent waterways. Pervious grounds provide a higher degree of precipitation infiltration. Rapidly moving water from floods can result in damage to buildings, bridges, and roads. Coastal floods are usually caused by storm surges, waves created by strong winds, and heavy rains associated with hurricanes, tropical storms, nor'easters and other large storm systems.

FEMA's HAZUS-MH software was developed to give better understanding of the risks associated with natural disaster, through use of geospatial modeling. This powerful software utilizes most recent U.S. Census data for analysis. Users input geographic localities and develop scenarios based on different environmental factors. The latest version (v4.2) was used to generate 100 year flood scenarios for the various NSVRC jurisdictions. On a county level, drainage areas of 2 miles were identified to develop a stream network. On a town/city level, the drainage areas were delineated at 0.25 miles. The delineation levels can be compared to map resolutions; a lower drainage area yields a higher level of detail.

The 2007 Plan included descriptions of major flood events in Appendix D that occurred in the Northern Shenandoah Region. Events have been categorized by the date of occurrence and where available, by individual community descriptions. When no community-specific description is available, the general description represents the entire planning area. Updated events since the 2007 were included in the beginning of this chapter.

Specific areas that are susceptible to flooding were determined by using the FEMA HAZUS floodplain data and the information collected during the project kick-off meeting. Flooding in the region tends to be riverine in nature along the tributaries of the Shenandoah River. Localized flooding also can occur in the narrow valleys throughout the area and in the more urbanized areas where impervious surfaces exacerbate flood conditions. Flooding in the NSV has some variation due to drainage areas. For many of the upland areas along the slopes of the Blue Ridge, there are steep narrow valleys that flood during localized precipitation events. In some urban areas there exists a combination of small drainage areas and an undersized stormwater drainage system that can cause localized flooding. For the Towns in the region that are located along the North or South forks of the Shenandoah River, the flood warning time is slightly greater, but events like Hurricane Isabel can quickly cause flooding along the many meanders of the rivers. It is important to note that the Counties and Towns are currently assessing stormwater detention basins and evaluating their effectiveness. The stormwater detention basins evaluated are those located within County jurisdictions through a regional Chesapeake Bay TMDL grants.

Many factors contribute to the relative vulnerabilities of areas within the floodplain. Some of these factors include development or the presence of people and property in the floodplain, flood depth, flood velocity, elevation, construction type, and flood duration. The current list of repetitive loss properties is presented in Appendix E, supporting documentation. A majority of the repetitive loss structures in the region are single family homes, though the structures with the highest claims are non-residential. The total amount paid on the repetitive loss structures for the region is more than six million dollars.

The impact of flooding on structures was estimated based on best available data for floodplains and structures for each community. HAZUS-MH software was used to estimate county/town level losses, following 100 year flood event. Quick Assessment (QA) reports provide information regarding regional statistics, including building exposure estimated in dollar amounts. The QA's also list the results of the 100 year flood scenario. Results from the HAZUS-MH Quick Assessment are displayed below in table 4.1.

Table 4.1 - Northern Shenandoah Valley Region HAZUS-MH 100 Year Flood Scenario Quick Analysis

Locality	Residential Building Exposure ($ Millions)	Total Building Exposure ($ Millions)	Displaced Households	People Seeking Shelter	Residential Property (Capital Stock) Losses ($ Millions)	Total Property (Capital Stock) Losses ($ Millions)	Business Income Interruption Losses ($ Millions)
Clarke County	***1,860***	***2,207***	***75***	***3***	***17***	***21***	***8***
Berryville	*466*	*623*	*50*	*5*	*2*	*4*	*11*
Boyce	*77*	*82*	*2*	*0*	*0*	*0*	*0*
Frederick County	***7,671***	***9,055***	***270***	***10***	***44***	***54***	***17***
Middletown	*115*	*142*	*4*	*0*	*0*	*0*	*0*
Stephens City	*191*	*232*	*20*	*1*	*1*	*1*	*1*
Page County	***2,075***	***2,533***	***150***	***7***	***27***	***35***	***23***
Luray	*459*	*610*	*45*	*2*	*5*	*8*	*13*
Shenandoah	*195*	*242*	*6*	*0*	*1*	*1*	*0*
Stanley	*108*	*132*	*9*	*0*	*1*	*1*	*0*
Shenandoah County	***4,520***	***6,213***	***670***	***74***	***204***	***266***	***87***
Edinburg	*107*	*177*	*19*	*0*	*3*	*6*	*2*
Mount Jackson	*175*	*810*	*30*	*6*	*3*	*6*	*6*
New Market	*187*	*397*	*9*	*1*	*1*	*3*	*4*
Strasburg	*566*	*692*	*42*	*2*	*4*	*9*	*4*
Toms Brook	*33*	*42*	*3*	*0*	*0*	*1*	*14*
Woodstock	*557*	*819*	*37*	*0*	*3*	*11*	*7*
Warren County	***4,030***	***4,806***	***466***	***40***	***87***	***139***	***118***
Front Royal	*1,384*	*1,825*	*214*	*19*	*20*	*49*	*83*
Winchester	***2,482***	***3,849***	***149***	***24***	***13***	***51***	***76***
NSVR Total	***22,638***	***28,663***	***1,780***	***158***	***392***	***566***	***329***

Table 4.1 - Northern Shenandoah Valley Region HAZUS-MH 100 Year Flood Scenario Quick Analysis

Global Assessment reports on vulnerabilities associated with a 100 year flood scenarios for each county and their respective localities are included in Appendix D, and provide a more detailed look at NSV Region localities vulnerability associated with a 100 year flood scenario. Global Assessments include the following:

- **General Description of the Region**
- **Building Inventory**
  - **General Building Stock**
  - **Essential Facility Inventory**
- **Flood Scenario Parameters**
- **Building Damage**
  - **General Building Stock Damage**
  - **Essential Facilities Damage**
- **Induced Flood Damage**
  - **Debris Generation**
- **Social Impact**
  - **Shelter Requirements**
- **Economic Loss**
  - **Building-Related Losses**
- **Appendix A: County Listing for the Region**
- **Appendix B: Regional Population and Building Value Data**

The impacts of flooding on critical facilities can significantly increase the overall effect of a flood event on a community. It should be noted that these facilities have been determined to be in the floodplain using Geographic Information Systems (GIS) and that this analysis should be used only as a planning tool. In order to accurately determine if a structure is actually in the floodplain, site-specific information must be available. Twenty-four critical facilities have been identified as being in the floodplain, as displayed in table 4.2.

Table 4.2 - Northern Shenandoah Valley Region Critical Facilities in Special Flood Hazard Area		
Facility Name	**Type**	**Jurisdiction**
F&M Bank Educational Center	School	Town of Berryville (Clarke County)
Keystone Christian Academy	School	Town of Berryville (Clarke County)
Duncan Memorial United	Church	Town of Berryville (Clarke County)
New Hope Baptist Church	Church	Frederick County
Meadowbrook Freewill Baptist	Church	Town of Middletown (Frederick County)
Strasburg Public Works Facility	Government	Town of Strasburg (Shenandoah County)
Melkite Greek Catholic Church	Church	Warren County
Warren County Administration Building	Government	Town of Front Royal (Warren County)
Front Royal Volunteer Fire Department	Fire & Rescue	Town of Front Royal (Warren County)
Dynamic Life Praise and Worship	Church	Town of Front Royal (Warren County)
Shenandoah University	School	City of Winchester
Winchester United Methodist	School	City of Winchester
Winchester City Sheriff	Police	City of Winchester
Winchester City Hall	Government	City of Winchester
Rouss Fire Company	Fire & Rescue	City of Winchester
Calvary Baptist Church	Church	City of Winchester
Celebration Fellowship	Church	City of Winchester
Christ Episcopal Church	Church	City of Winchester
First Presbyterian Church	Church	City of Winchester
Grace Evangelical Lutheran Church	Church	City of Winchester
John Mann United Methodist Church	Church	City of Winchester
Market Street United Methodist	Church	City of Winchester

Table 4.2 - Northern Shenandoah Valley Region Critical Facilities in Floodplain – Source: ESRI

NFIP Repetitive Loss Properties and Severe Loss Properties

The National Flood Insurance Program (NFIP) Repetitive Loss Strategy is a combined effort between FEMA' s Mitigation Directorate and the Federal Insurance Administration (FIA) that identifies properties most at risk for repeat flooding, and to reduce their flood exposure through targeted acquisition, relocation, and or elevation. The definition of severe repetitive loss as applied to this program was established in section 1361A of the National Flood Insurance Act, as amended, 42 U.S.C. 4102a. An SRL property is defined by FEMA as a residential property that is covered under an NFIP flood insurance policy and:

1. **The NFIP defines Repetitive Loss as 2 or more claims of at least $1000 over a 10 year rolling period. This is the data that appears in this plan.**

2. **The Hazard Mitigation Assistance program defines Repetitive Loss as having incurred flood-related damage on 2 occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and, at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.**

A FEMA AW501 form, along with the transmittal sheet or other document signed by an authorized community official, must be submitted for each repetitive loss property mitigated. This form can be found in appendix F of this plan.

VDEM provided a list of repetitive loss properties in the NSV region. Many of these repetitive loss properties are not currently insured, some have already had structural or non-structural mitigation (acquired and removed, elevated, or flood proofed), and others may have dropped insurance coverage for economic or coverage reasons.

According to the VDEM distributed list, there are 138 properties designated as being repetitive loss properties within the region. The average amount paid for these losses is $28,118.67. There are also 4 properties designated as Severe Loss properties located within the region, 3 in Warren County and 1 in Page County. Table 4.3 displays the number of NFIP designated Repetitive Loss Properties.

Table 4.3 - Northern Shenandoah Valley NFIP Repetitive Loss Properties

Locality	NFIP Repetitive Loss Properties
Clarke County	***9***
Frederick County	***5***
Page County	***17***
Shenandoah County	***48***
Warren County	***59***
Winchester	***0***
NSVR Total	***138***

Table 4.3 – Northern Shenandoah Valley Region NFIP Repetitive Loss Properties – Source: VDEM

Nationally, these buildings are projected to cost the NFIP $200 million per year. Additionally, new repetitive loss properties are identified each year. FEMA has identified target buildings that are currently insured and have the greatest risk. There are 8,753 buildings with four or more losses, and 1,160 buildings with two or three losses that exceed building value. Although most target buildings are single-family residences, 25 percent of the dollar losses are to non-residential buildings. FEMA regional offices are making this information available to VDEM and NSVRC. According to FEMA, these properties will cost an estimated average of $57,500 to acquire, relocate, or floodproof (Federal share is $43,125 at a 75/25 cost share). The projected mitigation costs assume that half the buildings will be acquired or relocated and half will be elevated or floodproofed. FEMA will continue to work with VDEM as a partner to effectively use HMGP funds to mitigate target properties. To assist in remediating these properties FEMA has developed the NFIP Community Rating System (CRS) that assigns credits for acquisition, relocation, and retrofitting of floodprone properties with bonuses added for removing repetitive loss buildings.

Communities that have 10 or more repetitive loss properties are required to address these and other at-risk structures for mitigation options in a floodplain management plan. VDEM provided NSVRC with a list of repetitive loss properties located within the planning region (Appendix E). The steering committee was provided with copies of the repetitive loss properties. As a regional strategy, all participating jurisdictions have prioritized mitigating repetitive loss properties by acquisition and relocation or elevations and other structural improvements.

All jurisdictions with the exception of the Town of Boyce participate in NFIP and plan to continue compliance with NFIP requirements. The Town of Boyce will seek full participation as staff and flood maps are available and continue compliance with NFIP requirements through Clarke County. The CRS provides premium discounts in communities that exceed NFIP minimum requirements.

The hazard mitigation steering committee has identified CRS as an important resource and is working to better understand how localities can participate. NSVRC will continue advance the CRS program information to planning directors and chief administrative officers to encourage the jurisdictions to consider participation in the CRS program.

Future Conditions Analysis - Flooding

Specific areas that are susceptible to flooding were determined by using the FEMA floodplain data and the information collected during the project kick-off meeting. Flooding in the region tends to be riverine in nature along the tributaries of the Shenandoah River. Localized flooding also can occur in the narrow valleys throughout the area and in the more urbanized areas where impervious surfaces exacerbate flood conditions. Flooding in the Northern Shenandoah Valley has some variation due to drainage areas. For many of the upland areas along the slopes of the Blue Ridge, there are steep narrow valleys that flood during localized precipitation events. This also applies to the City of Winchester, where a combination of small drainage areas and an undersized stormwater drainage system can cause localized flooding. For the towns in the region that are located along the North or South forks of the Shenandoah River, the flood warning time is slightly greater, but events like Hurricane Isabel can quickly cause flooding along the many meanders of the rivers.

Many factors contribute to the relative vulnerabilities of areas within the floodplain. Some of these factors include development or the presence of people and property in the floodplain, flood depth, flood velocity, elevation, construction type, and flood duration. These vulnerabilities were outlined using FEMA HAZUS software analysis, which can be referenced in the appendix of this plan.

Winter Storms/Ice/Extreme Cold

The primary impacts of winter storms are minimal in terms of property damage and long-term effects. The most notable impact from winter storms is the damage to power distribution networks and utilities. Severe winter storms have the potential to inhibit normal functions of the community. Governmental costs for this type of event are a result of the personnel and equipment needed for clearing streets. Private sector losses are attributed to lost work and lost sales when employees and customers are unable to travel. Homes and businesses suffer damage when electric service is interrupted for long periods of time. Health threats can become severe when frozen precipitation makes roadways and walkways very slippery, when there are prolonged power outages, or if fuel supplies are jeopardized. Occasionally, buildings may be damaged when snow loads exceed the design capacity of their roofs or when trees fall due to excessive snow or ice accumulation on branches. The primary impact of excessive cold is increased potential for frostbite and potentially death as a result of over-exposure to extreme cold. Some of the secondary effects presented by winter weather and extreme cold are danger to livestock and pets, and frozen water pipes in homes and businesses.

Winter storms can consist of a combination of heavy snowfall, high winds, ice and extreme cold. Winter weather typically impacts the state of Virginia between the months of November and April, with varied intensities from east to west.

Future Conditions Analysis – Winter Storms/Ice/Extreme Cold

Western portions of Frederick County have a moderate potential for snowfall in relation to the rest of the Northern Shenandoah Valley region because this part of the county is at a higher elevation and temperatures are colder. Eastern Frederick County and the City of Winchester have a lower potential for significant snowfall because they are at a much lower elevation and are typically warmer.

Southern and eastern Clarke County falls within the moderate category for snowfall because of the higher elevation Shenandoah mountain range that exists within these areas, creating a colder climate.

Eastern Warren County has a higher potential for snowfall than western Warren because the Shenandoah Mountains make up the eastern border of this county, causing lower temperatures.

Central Shenandoah County has a low potential for snowfall because it is within the valley of the surrounding Shenandoah mountain ranges to the east and west. These two mountain ranges are what make the outer regions of this county fall into the moderate potential category.

Southern Page County has the highest relative potential for snowfall because this region receives the most winter precipitation and is also at the higher elevations of the Shenandoah Mountains.

VDOT and power company resources are allocated to areas of highest population. The highest risk areas for Winter Storm related hazards are rural, mountainous, low density populated areas. These areas should be of highest concern for readiness prior to major winter storm events.

Hurricanes/High Winds

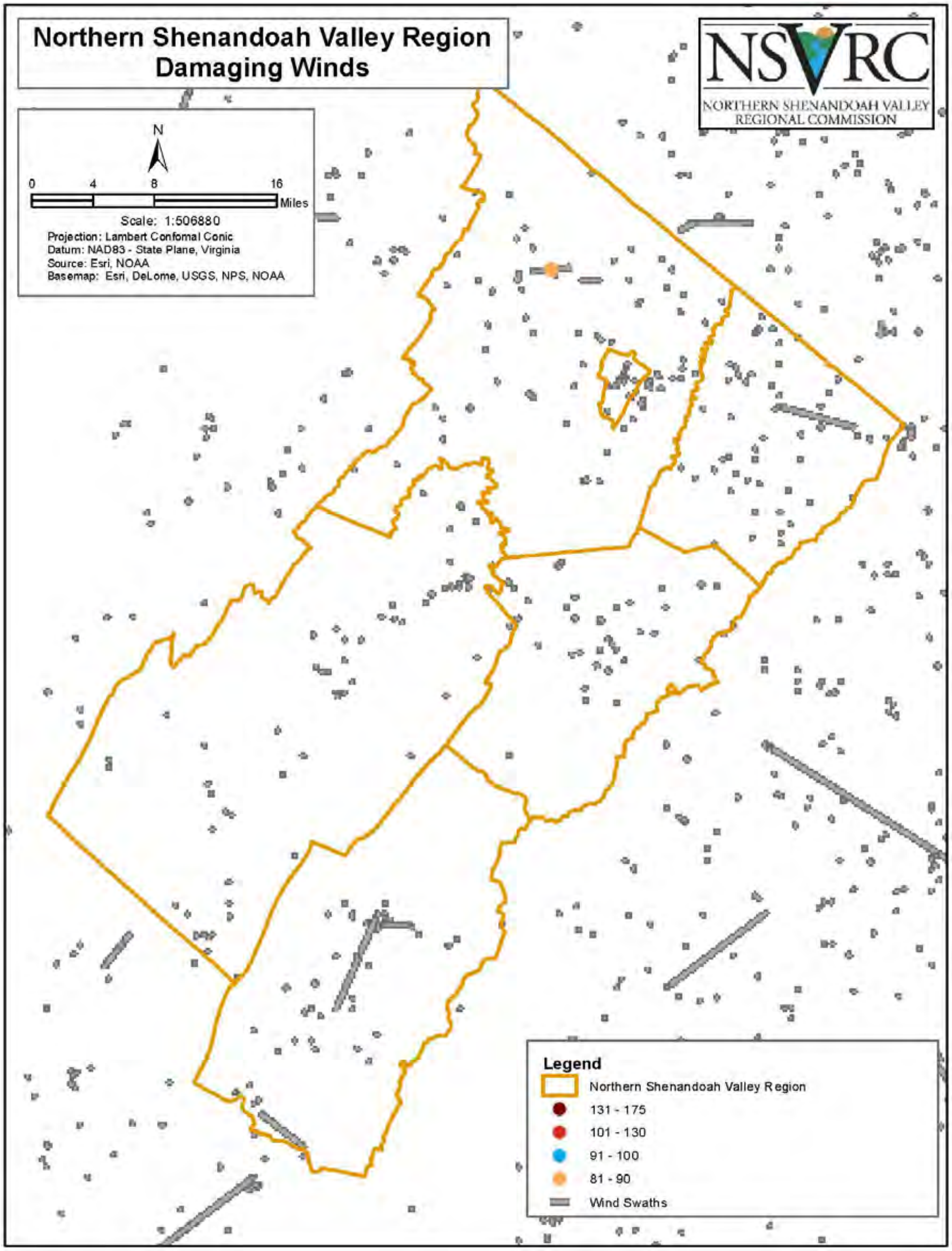


Figure 4.2 – Northern Shenandoah Valley Region Damaging Winds

Major hurricane events since the 2012 Plan include Hurricane Sandy in 2012, and hurricane Matthew in 2016 that passed through the NSV region, resulting in high wind damages, flooding and power outages. The Commonwealth of Virginia's Standard Hazard Mitigation Plan includes hurricane tracks in Virginia based on a historical representation of occurrences in the Northern Shenandoah region. Two hurricanes are known to have tracked through the NSV since 1851. In 1893, an unnamed hurricane tracked through Shenandoah County. In 1896, an unnamed hurricane tracked through the Counties of Page, Warren, Frederick and the City of Winchester.

Hurricanes that have not tracked through the region still have had a considerable impact on the region. Notably, secondary impacts have caused loss of life, injury, property damage and widespread infrastructure damage (i.e. power and phone disruptions). An unnamed hurricane in 1893 tracked to the southeast of the region, as well as Hurricane Hazel in 1954. Hurricane Isabel in 2003 tracked to the southwest of the region in Rockingham County as a Category 1 hurricane and eventually weakened to a tropical storm. Hurricane Isabel impacted the Shenandoah National Forest from Page County through Front Royal's Big Meadows. Skyline Drive and several trails were closed one night and the park employees were evacuated to a shelter. Damage throughout the greater Shenandoah Valley from Isabel total about $29 -34 million (2008 USD estimates). The flooding from the hurricane killed 25-30 head of livestock in the Valley.

The likelihood of a hurricane affecting the NSV region is low based the history of occurrences. However, in the event a hurricane passes through the planning region, each locality likely to be affected equally. Based on the date of occurrences and where available, by individual community descriptions, the following community-specific impacts are anticipated in the event a hurricane hits the planning region.

The 2012 Plan presented a detailed vulnerability analysis using HAZUS-MH for wind analysis for vulnerability and loss estimates. The HAZUS-MH used historical hurricane tracks and computer modeling to identify the probable tracks of a range of hurricane events. The results of the 2007 Plan were determined to continue to be most reflective of the vulnerability analysis with highest wind speeds over the next 50 years (see Appendix F, 2007 Plan).

HAZUS MH EARTHQUAKE • WIND • FLOOD

FEMA

RiskMAP

Quick Assessment Report

February 9, 2018

Study Region : NorShen

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	1,646
Number of Census Tracts	44
Number of People in the Region	222,152

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	88,875	22,636,669
Commercial	4,656	3,133,440
Other	3,116	2,891,545
Total	96,647	28,661,654

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	4	0	0	0	4
100	17	0	0	0	17
200	87	1	0	0	89
500	767	38	0	1	806
1000	1,044	39	0	0	1,083

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	9	0	0	0	9
100	28	0	0	0	28
200	114	1	0	0	115
500	835	42	1	1	879
1000	1,127	42	0	0	1,170

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption (Income) Losses*
ReturnPeriod	*Residential*	*Total*	
10	0	0	0
20	0	0	0
50	0	0	0
100	2,087	2,115	0
200	9,407	9,663	11
500	28,812	30,610	1,071
1000	49,461	50,741	1,408
Annualized	247	261	12

Future Conditions Analysis – Hurricanes/High Winds

The assessed property damage in the Plan update was based on 63% of the total property values as indicated below being wood-frame. Similar breakdowns were used from the 2012 to assess impacts to residential versus commercial/industrial property, where 79% of the impacts would be to residential property and 17.33% of the impacts would occur to commercial/industrial property.

Probabilistic wind speeds (50-, 100- and 1,000-year return period peak gust in miles per hour) were predicted by the FEMA HAZUS-MH model for the NSV region, as shown on the 50-year probabilistic wind event map. The northern portions of Frederick, Clarke and Warren Counties and City of Winchester are dominated by wind speeds less than 50 mph. The central and southern portions of the planning area were found to be dominated by 50 to 60 mph winds. The 100-year probabilistic wind event map is uniform throughout the region with 60 to 70 mph winds. As with the 50-year wind event, the 1,000-year wind event follows the same trend, with 80 to 90 mph winds in the northern portions and 90 to 100 mph winds in the central and southern portions of the region. The impacts of these various events are combined to create a total annualized loss or the expected value of loss in any given year.

The global risk assessment for Hurricanes located in Appendix G, presents the probabilistic building stock exposure by building type, based on 2010 U.S. Census data. Based on the HAZUS vulnerability assessment, the greatest wind damage would be to wood-frame buildings (66% of housing stock, based on 2010 Census data). For the NSV region, wood-frame buildings account for a large percentage of the building stock (66%). Approximately 79% of the building stock for the NSV region is considered residential, and approximately 6.4% of the building stock is commercial and/or industrial. Town exposure has been estimated as a percentage of the total housing units in the County. The County totals include the Town subtotals.

Tornadoes

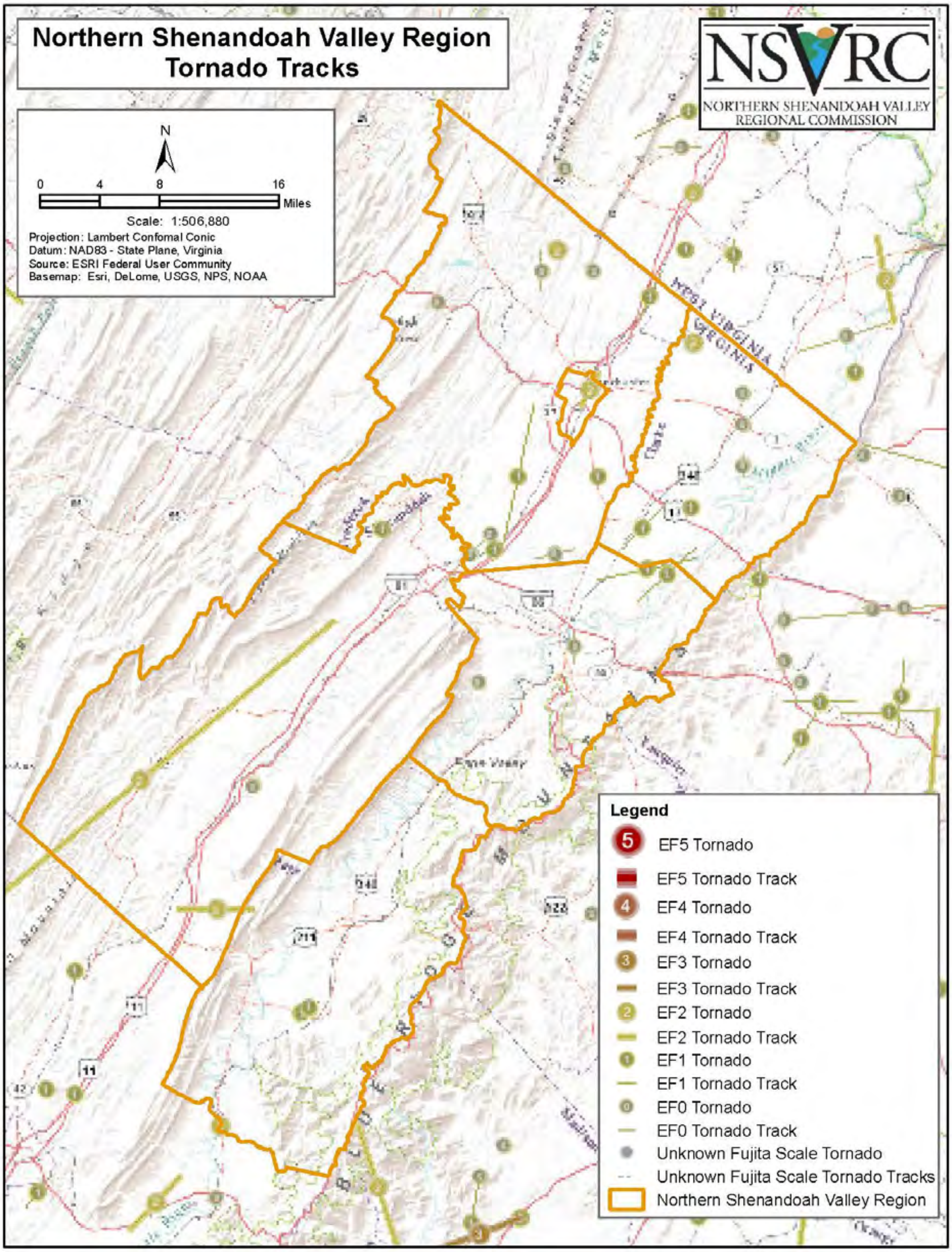


Figure 4.3 – Northern Shenandoah Valley Region Tornado Tracks

Tornadoes are windstorms characterized by funnel clouds extending to the ground from the clouds. Tornadoes can 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. Often hail accompanies tornadoes and can cause damage in addition to the gusting winds. On average, there are about 1,200 tornadoes with 80 storm-related deaths and 1,500 injuries reported across the United States annually. Tornado season runs from late winter to mid-summer, primarily in the southeast. Tornado wind speeds vary and surface impact from a brief touch down to a more severe extended surface contact. The Fujita Scale, as modified in 2007 by findings in the Building Assessment Report, Midwest Tornadoes of May 3, 1999, uses damage caused by a tornado and relates the damage to the fastest 1¼-mile wind at the height of a damaged structure (NWS, 2012 website). The modified Enhanced Fujita scale (EF scale) is based on damage from 28 indicators and a finding of a degree of damage. The degree of damage is based on estimate of wind speed, a lower bound of wind speed and an upper bound of wind speed, building material and density of structures.

- F0 (Gale force winds)
- F1 (Weak)
- F2 (Strong)
- F3 (Severe)
- F4 (Devastating)
- F5 (Incredible)

July is the most common month for tornadoes in Virginia with an average of FO to F1 storms (Storm Prediction Center, National Weather Service).

Future Conditions Analysis – Tornadoes

Based on historical occurrences, the entire Commonwealth is vulnerable to thunderstorm and tornado activity. These natural hazards are often associated in tandem or where tornados occur as a result from severe thunderstorm activity. As noted above, tornados may also occur during a tropical storm or hurricane. The probability of a severe thunderstorm occurring in the planning region is medium, while the probability for a tornado is low. The vulnerability analysis was considered to be equal for the entire planning region, since there is neither precise location nor prediction of where and to what extent thunderstorm and tornado damage may occur, therefore, the total dollar exposure figure of $2,460,591,521 for buildings and facilities within the region is considered to be exposed and could potentially be impacted. The total planning region population of 232,295 (July 1 , 2016 – U.S. Census Bureau) is considered to be affected as well. 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.

Thunderstorm/Hail/Lightning

According to the National Weather Service (NWS), 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 tornadoes, hailstorms, strong winds, damaging lightning, and flash floods. Thunderstorms occur in all regions of the United States and are very common in the NSV region. Thunderstorms form when moist, unstable air is lifted vertically into the atmosphere and the rising air cools, condenses, and forms thunder clouds cumulus and cumulonimbus clouds. Thunderstorms may occur singly, in lines, or in clusters and may move through an area very quickly or linger in place for several hours. Lightning 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 and according to National Severe Storms Laboratory, under NOAA, in Virginia most lightning strikes occur under trees and second in open spaces. Lightning often results in power outages across wide areas. Hail can be associated with severe thunderstorms, tornadoes, and winter storms. Hail can cause damage to roofs and flat metal surfaces such as cars. Hail is often experienced for a short duration; however its impacts can be destructive. As noted on the National Weather Service NOAA-NWS-NCEP Storm Prediction Center website, derecho winds are the product of what meteorologists call downbursts. A downburst is a concentrated area of strong wind produced by a convective downdraft. A typical derecho consists of numerous downburst clusters ("families of downburst clusters") that are in turn, comprised of many smaller downbursts, microbursts, and burst swaths.

A number of presidential disaster claims have come from the result of severe thunderstorms, specifically those stemming from hurricanes and tropical depressions. Since the 2007 update, 7 declarations were made in reference to an event that included severe thunderstorms. Virginia averages 35 to 45 thunderstorm days per year.

Power outages are common during thunderstorms. Generators are used to keep critical facilities active during outages. The Department of Environmental Quality inventories and regulates generator permits. According to their database, 118 generators are located throughout the region – as mapped in figure 4.5 below. An interactive map that reveals facility names and locations is posted to the Hazard Mitigation Online Portal.

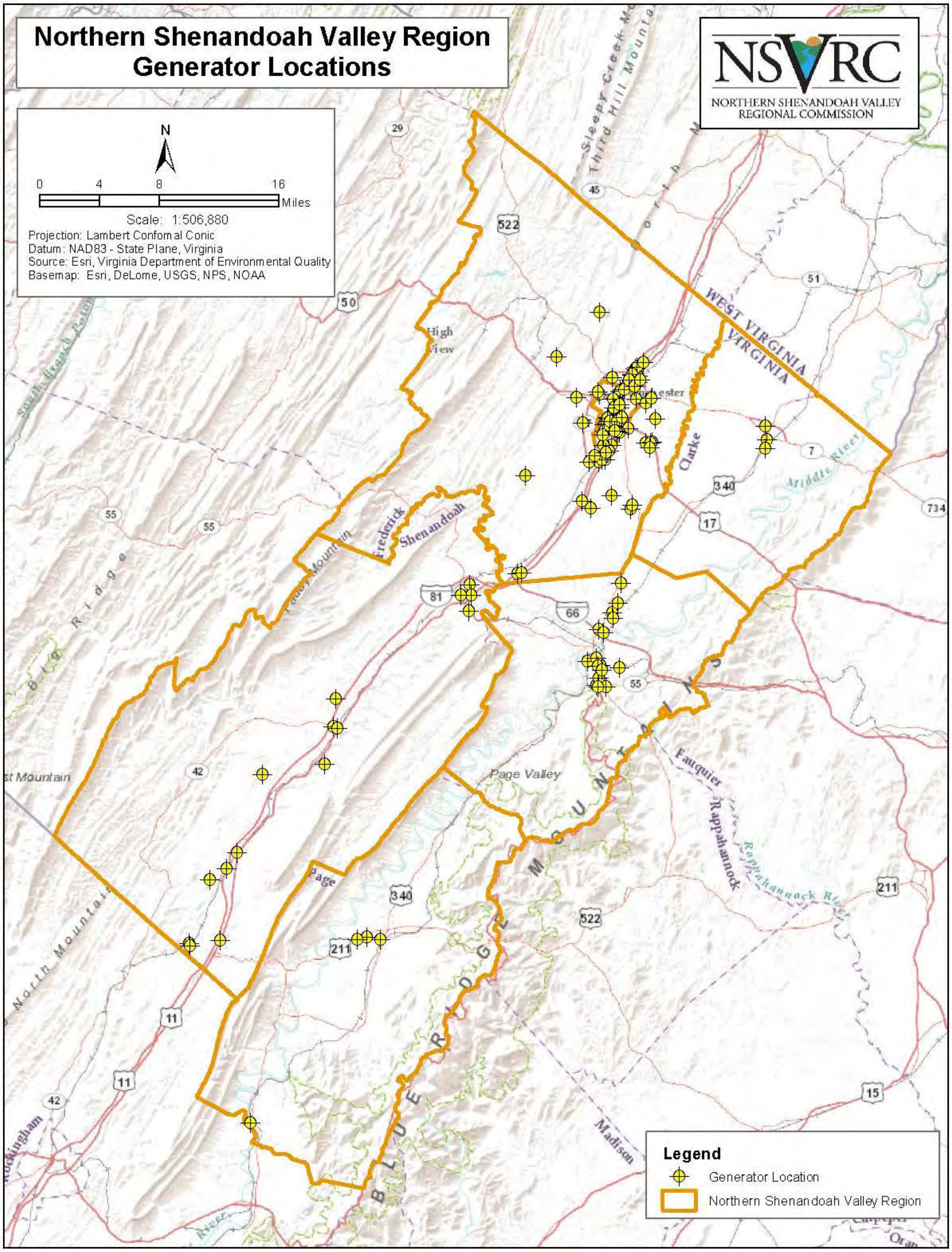


Figure 4.4 – Northern Shenandoah Valley Region Generator Locations

Future Conditions Analysis – Thunderstorms/Hail/Lightning

Thunderstorms can occur any day of the year and at any time of the day, but are most common in the late afternoon and evening during the summer months. Though thunderstorms provide needed rain for crops, plants and reservoirs, about five percent of thunderstorms become severe and can produce tornadoes, large hail, damaging downbursts and heavy rains that cause flash floods. The National Weather Service does not issue warnings for thunderstorms or for lightning unless it is severe, but the NWS does highlight the potential for thunderstorms in daily forecasts. Be alert to the signs of changing weather, such as darkening skies, a sudden wind shift or drop in temperature, and have a warning device such as NOAA Weather Radio. Staying alert can mean the difference between life and death when a thunderstorm approaches. (VAemergency.gov)

Warm, humid conditions during the spring and summer are favorable for the development of thunderstorms. Lightning that often accompanies thunderstorms has the potential to be life-threatening. While lightning fatalities have decreased over the past 30 years, lightning continues to be one of the top storm-related injuries in the United States. By knowing what to do during thunderstorms, you can greatly increase your safety and the safety of those around you. Thunderstorms typically produce heavy rain for a brief period, anywhere from 30 minutes to an hour. However, these storms have the ability to produce dangerous winds, hail, and lightning. In addition, they can cause flash flooding in rivers and streams, dry gulches, and in low-lying areas. If you hear the sound of thunder, then you are in danger from lightning. (VA Dept. of Health)

Wildfire

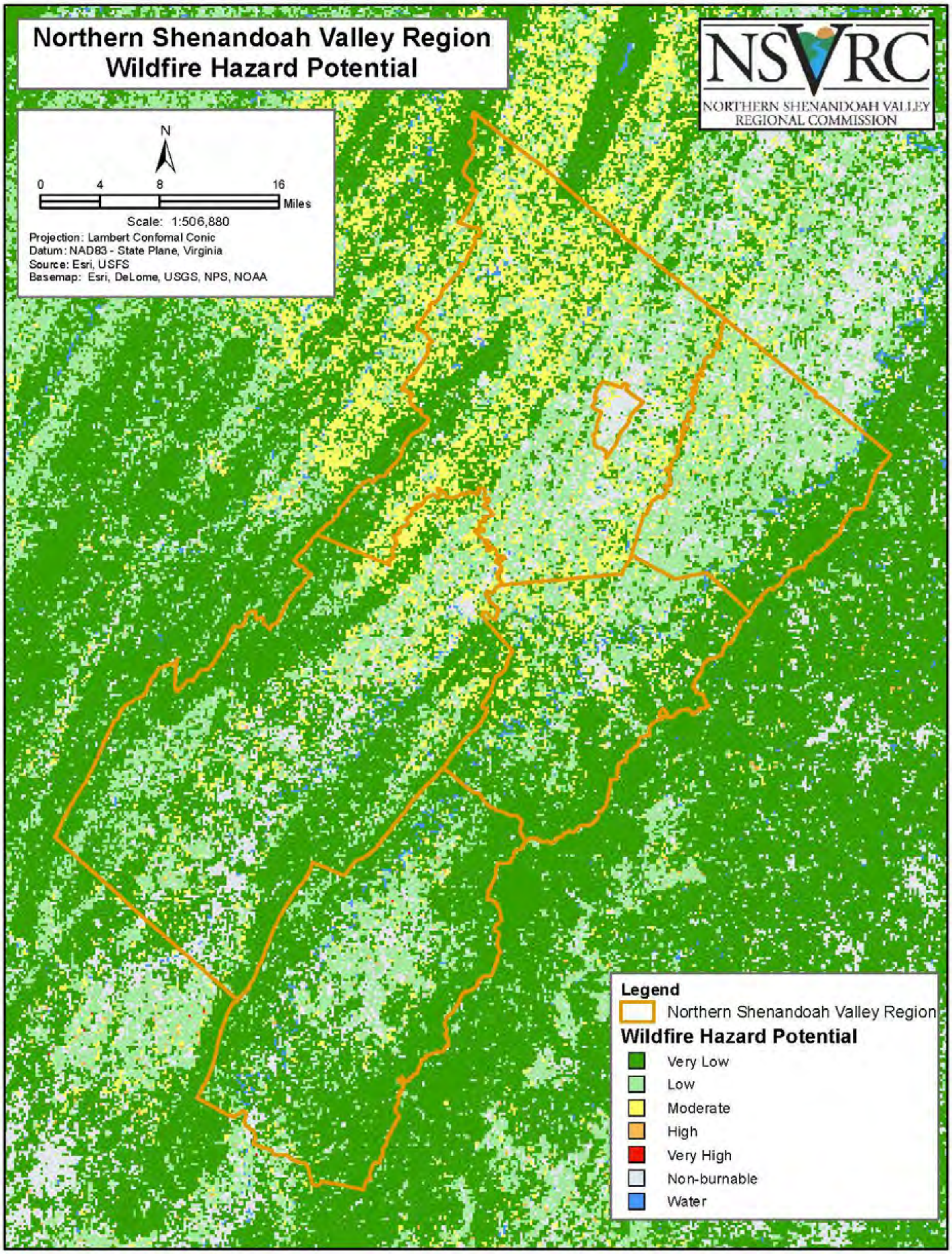


Figure 4.5 – Northern Shenandoah Valley Region Wildfire Potential

The risk assessment for wildfires was based on the number of woodland homes in proximity to forested areas. Since over 45% of the County's land cover is forested, the risk to woodland homes remains high. The VDOF's annual estimate of the number of woodland homes per County for 2017 is presented below in table 4.4. These are considered the communities and structures at highest risk.

Table 4.4 - Northern Shenandoah Valley Region Woodland Homes and Communities

Locality	# of Woodland Homes	Total Number of Structures	% of Woodland Homes/Communities
Clarke County	1,014	6,261	16.20%
Frederick County	2,819	33,385	8.44%
Page County	611	11,636	5.25%
Shenandoah County	626	21,026	2.98%
Warren County	2,738	16,099	17.01%
Winchester City	0	11,903	0.00%
NSVR Total	7,808	100,310	7.78%

Figure 4.4 – Northern Shenandoah Valley Region Woodland Homes and Communities – Source: 2017 VDOF

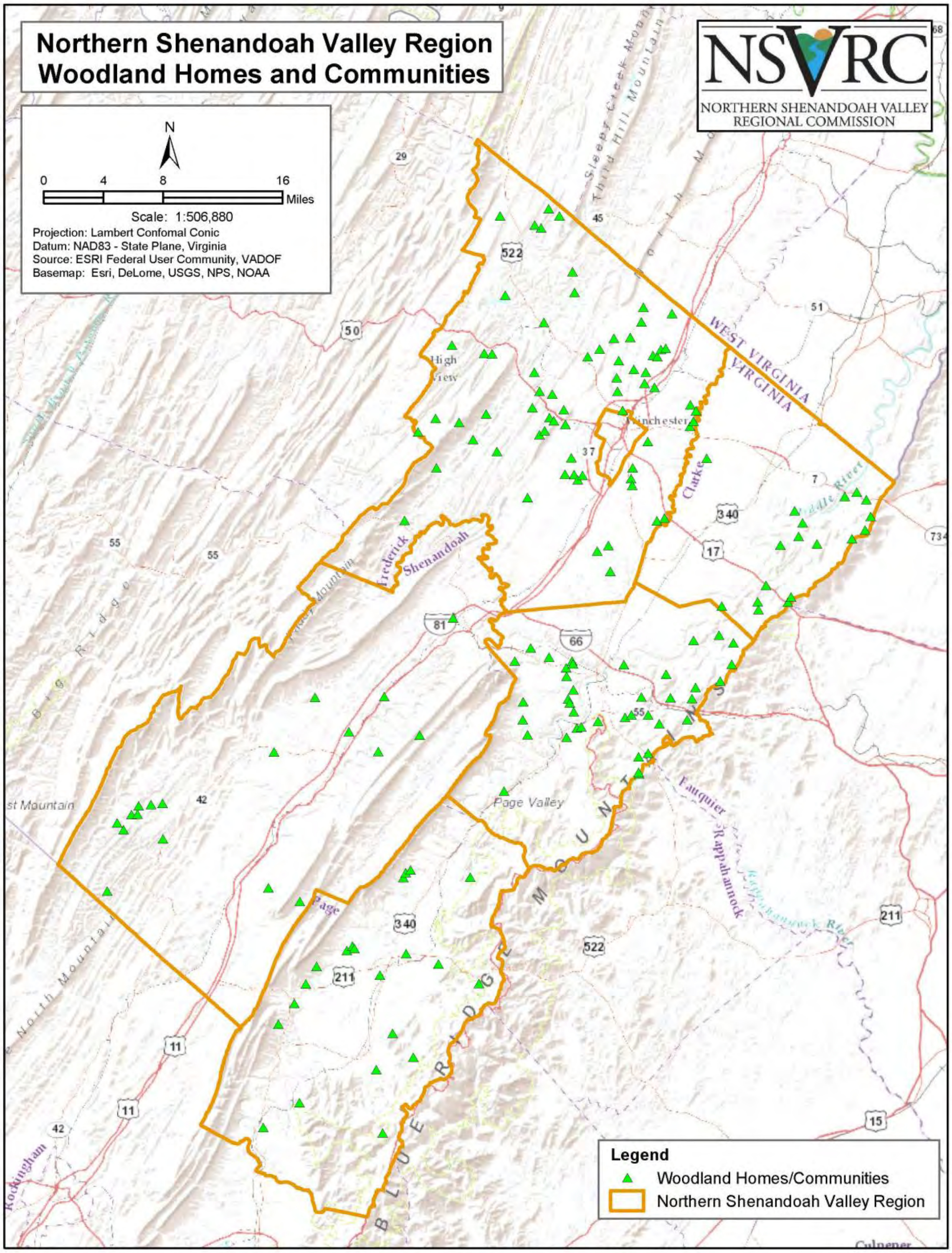


Figure 4.6 – Northern Shenandoah Valley Region Woodland Homes and Communities – Source: ESRI, VDOF, USGS, NOAA

The Virginia Department of Forestry completed 13 fuel reduction mitigation projects in woodland home communities within the NSV region since the 2007 Plan. During 2011 alone, five of these 13 fuel reduction projects were completed based on one mitigation project in Frederick County, two in Shenandoah County, and two in Warren County totaling approximately $25,000 in mitigation costs. In 2010, the VA Department of Forestry conducted three fuel reduction mitigation projects in woodland home communities within Page County, totaling $10,000. The remaining was between 2007 and 2010. Figure 4-3 presents the wildfire potential in the NSV region based on wildfire history, forests, and woodland homes, as provided by the Department of Forestry.

The participating jurisdictions in the NSV region participate in FIREWISE and have continued the strategy to participate in the program. Future evaluations of wildfire mitigation may consider Schwab and Meck's 2005 report to the Chicago American Planning Association "Planning for wildfires" *(Planning Advisory Service Report No. 529153̶0.* Chicago: American Planning Association.) The findings could be considered by land use planners in permitting future development in fire-prone areas and how best to design such developments to reduce the risk of damage and loss.

Future Conditions Analysis – Wildfire

The highest at-risk populations and structures, as assessed in the 2018 Plan, is a large percentage of the region's woodland homes fall into the high potential for a wildfire. This is an extremely high percentage, meaning almost all of the woodland homes are at a wildfire risk. Warren and Clarke Counties have the highest relative percentage of homes in areas of high wildfire potential, nearly all homes in the highest risk category due to proximity of woodland homes adjacent to forested areas. Frederick County has the third highest relative risk for wildfire with approximately 85% of woodland homes at risk. Frederick County has a high percentage of critical facilities at risk to wildfire (47%) followed by Warren County (29%). Overall, a relatively low number of critical facilities in the NSV are at risk to wildfire (24%) events.

In Warren County, an estimated 59% of the County's population lives in areas classified as having high wildfire potential, followed by Frederick County with 52% of its population living in areas of high wildfire potential. Critical facilities in Frederick and Warren Counties have the highest percentage of critical facilities in the high wildfire potential category. Overall the hazards listed in the 2018 update of this Plan remain the same as those ranking highest in the 2007 Regional Hazard Mitigation Plan. The results of this assessment remain the same as the 2012 due to the location of the critical facilities remaining static for those located in higher fire-risk areas between 2012 and 2017. Wildfires are usually started by human accidents or lightning. Since neither cause is predictable, the extent is considered to be the woodland communities in close proximity to the forests. It is worth noting that sequential years of drought can lead to environmental conditions that promote wildfires.

Dam Failure/Low Bridges

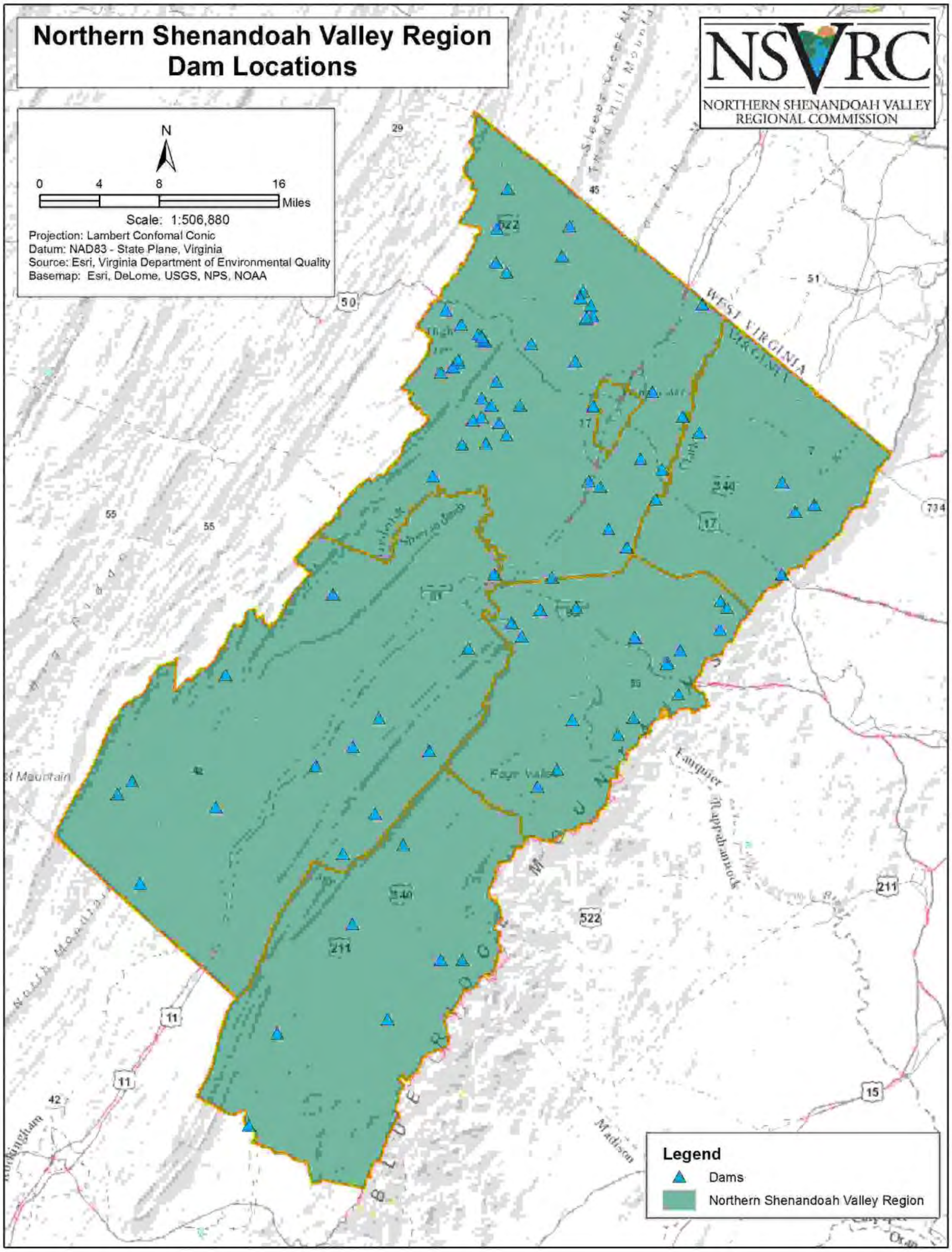


Figure 4.7 – Northern Shenandoah Valley Region Dam Locations – Source: ESRI, VADEQ

There are three Federal Energy Regulatory Commission licensed dams located within the planning region. In addition, there are numerous agricultural and other privately-owned dams. The Department of Conservation and Recreation (DCR) has hired an engineering firm to modify and improve the spillway for the Stoney Creek dam at Lake Laura in Shenandoah County. The downstream populations that were at risk from that dam are considered to be remediated with the completion of the spillway modification. The downstream impacts to structures, property and populations are not available for analysis at this time from the existing dams. DCR is conducting an inventory of the dams in Virginia and will be providing an assessment of the dam condition. This data will go into their new website that will be used to calculate downstream populations and areas that could be impacted in the event of a dam failure.

All dams in Virginia are subject to the **Dam Safety Act** and **Dam Safety Regulations** unless specifically excluded. A dam is excluded if it (VA Department of Conservation and Recreation):

- is less than six feet high;
- has a maximum capacity less than 50 acre-feet and is less than 25 feet in height;
- has a maximum capacity of less than 15 acre-feet and is more than 25 feet in height;
- is operated primarily for agricultural purposes and has a maximum capacity of less than 100 acre-feet or is less than 25 feet in height (if the use or ownership changes, the dam may be subject to regulation) [This exemption does not extend to the construction of the dam, which remains subject to the Act and Regulations];
- is owned or licensed by the federal government;
- is operated for mining purposes under 45.1-222 or 45.1-225.1 of the *Code of Virginia*;
- is an obstruction in a canal used to raise or lower water levels.

DCR issued a press release in June 2012 that it will partner with North Carolina's existing dam safety website. North Carolina's website is recognized as one of the best flood mapping and dam programs in the nation. The site will soon display Virginia flood maps, models, and data on flood hazards and risk for use by citizens, floodplain managers, emergency planners and responders. The Virginia data is due to appear on the website by "late-summer 2012"; however, no data was online at the time of this Plan update. The website will allow users to estimate flood damage and costs to properties from various storms on an individual and community-wide basis. The data will be used to support and prioritize mitigation actions and to increase education about hazard mitigation options to reduce flood danger and losses. Local governments, responsible for enforcing floodplain ordinances to enable their citizens to qualify for National Flood Insurance, will benefit from the statewide accessibility of digital maps and data. Local and state emergency responders also will benefit from easy access to this information to better protect lives and property.

Future Conditions Analysis – Dam Failures/Low Bridges

DCR is currently finalizing a guide for implementing the DCR dam break inundation zone regulations. This document provides guidance to calculate the "Dam break inundation zone" or that area downstream of a dam that would be inundated or otherwise directly affected by the failure of a dam. A regional datababse was created in order to develop the Dams map on the hazard mitigation online portal. These dams are inventoried with their most current data from DCR. A majority have condition ratings available in their attribute information. Future updates of this Plan may include updated data from DCR dam evaluations, in order to keep the webmap up to date. Localities can use the webmap for identifying dam/bridge locations, inventorying and viewing structure conditions, as well as monitoring neighboring stream flow rates.

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, persons with special needs, 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.

Future Conditions Analysis – Extreme Heat

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.

Populations at risk, as noted in the beginning of the ‘Population Profile (chapter 3, pg. 31), should be of highest concern when addressing local efforts towards mitigation of extreme heat conditions.

Drought

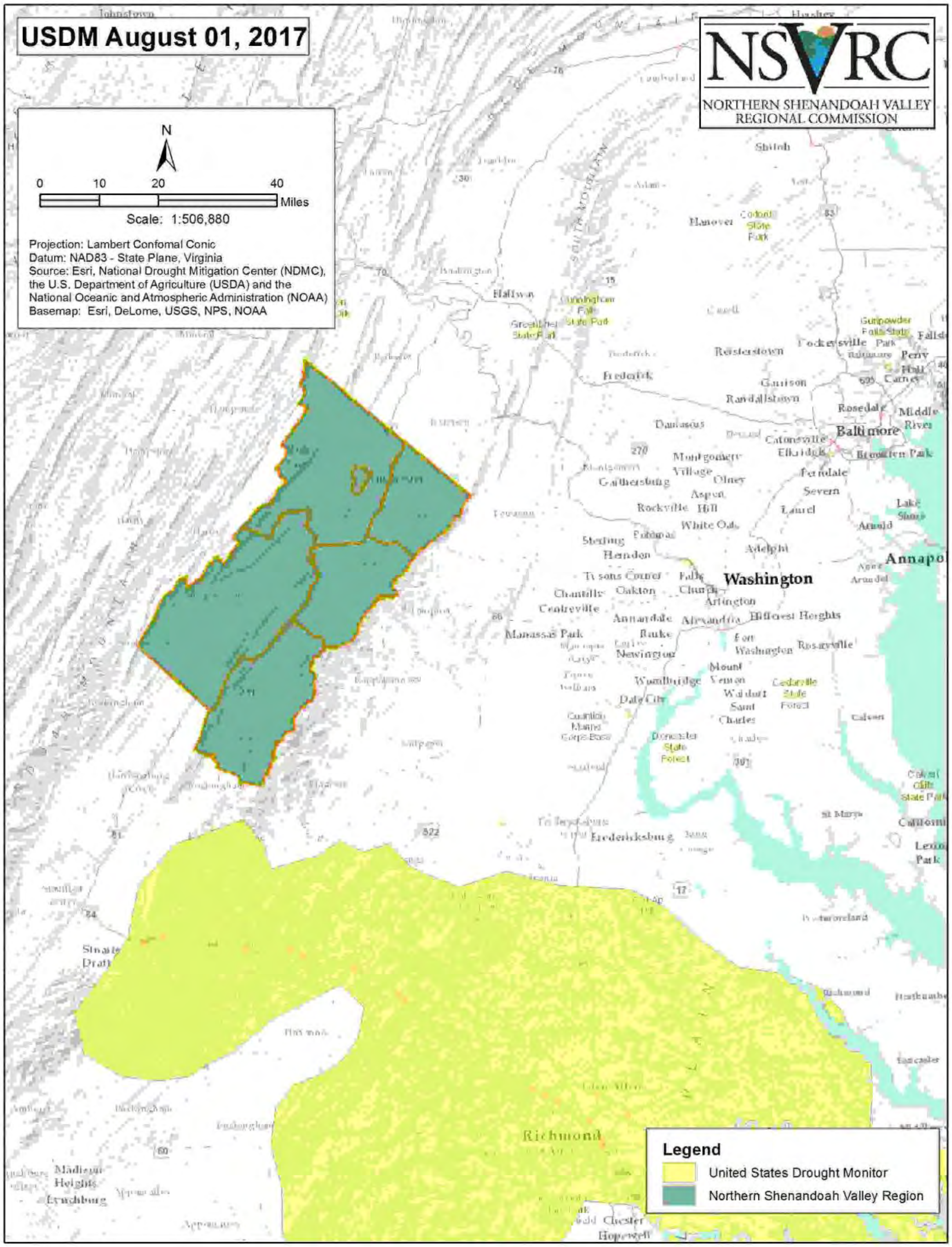


Figure 4.8 – United States Drought Monitor (August 2017) and the NSVRC – Source: ESRI, US Drought Monitor, USGS

Meteorological droughts are precipitation deficits compared to average, or normal, amounts of precipitation over a given period. Crop and livestock needs, soil moisture and groundwater presence affect 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. The Virginia Department of Environmental Quality maintains a drought map monitoring the Shenandoah Valley. Due to the topography of the Valley and the rain shadow of the mountains, the NSV region is prone to droughts if precipitation is low. Where other locations in Virginia might experience low precipitation, the NSV region may experience a drought watch or warning. The State Climatologist listed the Shenandoah Valley as the driest area in Virginia, with New River region also dry.

The localities of the planning region prepared and adopted a regional Water Supply Plan that was submitted to the Virginia Department of Environmental Quality on November 2, 2011. At the time of this plans drafting, the Regional Water Supply Plan is undergoing its mandated update. The regional Water Supply Plan identified a protocol for addressing and broadcasting droughts in the event of a climatic condition and methodology to disseminate information. The Water Supply Plan includes drought triggers for each locality and references a drought ordinance to be implemented in the event of a drought watch, warning, and emergency including voluntary and mandatory water conservation measures.

Future Conditions Analysis – Drought

Populations with less access to public/private water systems are of the highest risk during times of drought. When a drought occurs, these areas would likely feel a larger impact since most homes receive their water from wells, which may dry up during a drought. In terms of well usage, Page County has the highest vulnerable population percentage, followed by Frederick County. Towns have a considerably lower vulnerability to drought as a result of the various types of water supplies available.

The DEQ has a daily drought website for the NSV region based on precipitation, river flow, water well elevations, and soil moisture.

(http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/Drought/CurrentDroughtConditionsMap.aspx)

Earthquakes

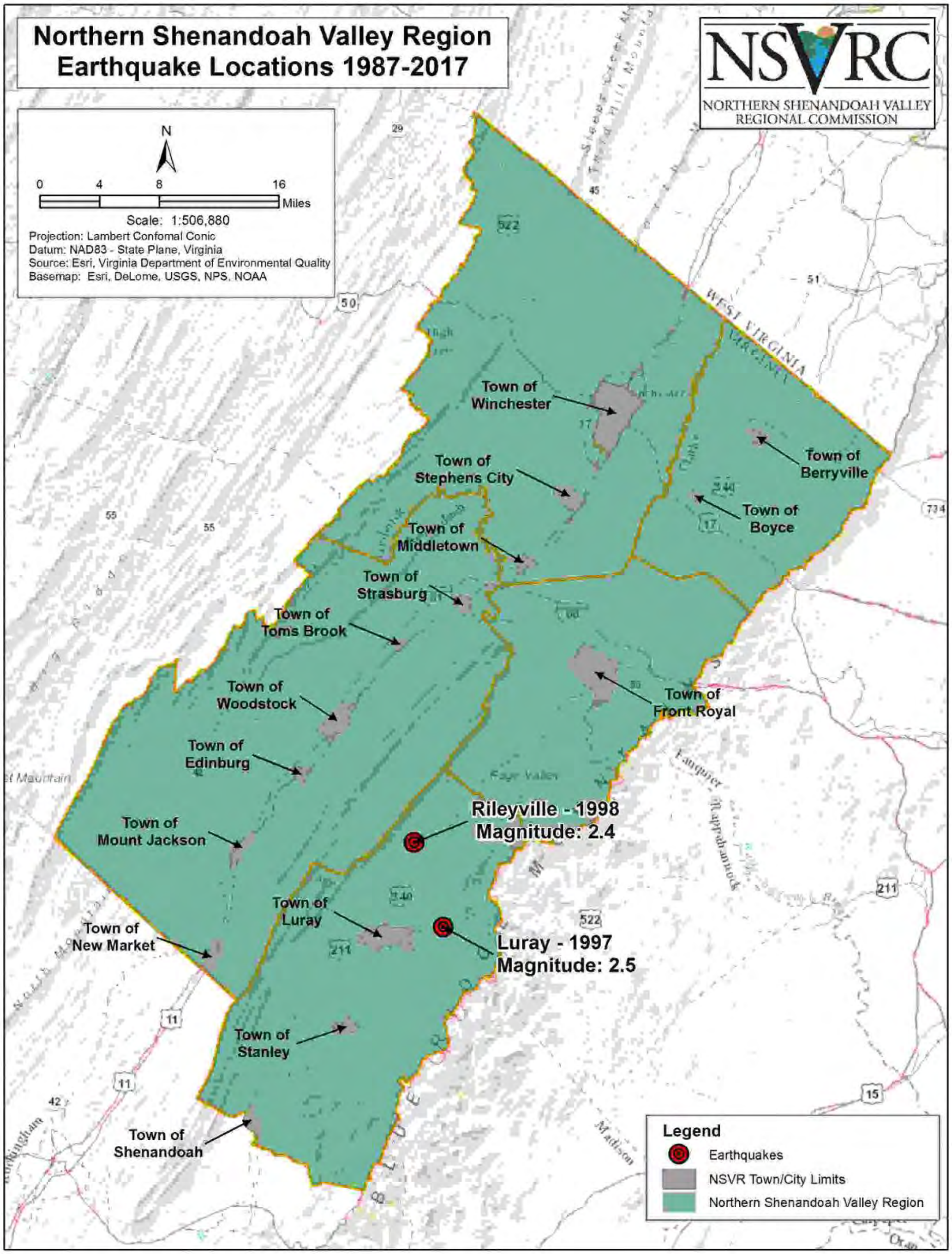


Figure 4.9 – Northern Shenandoah Valley Region Earthquake History – Source: ESRI, FEMA (HAZUS-MH), USGS, NOAA

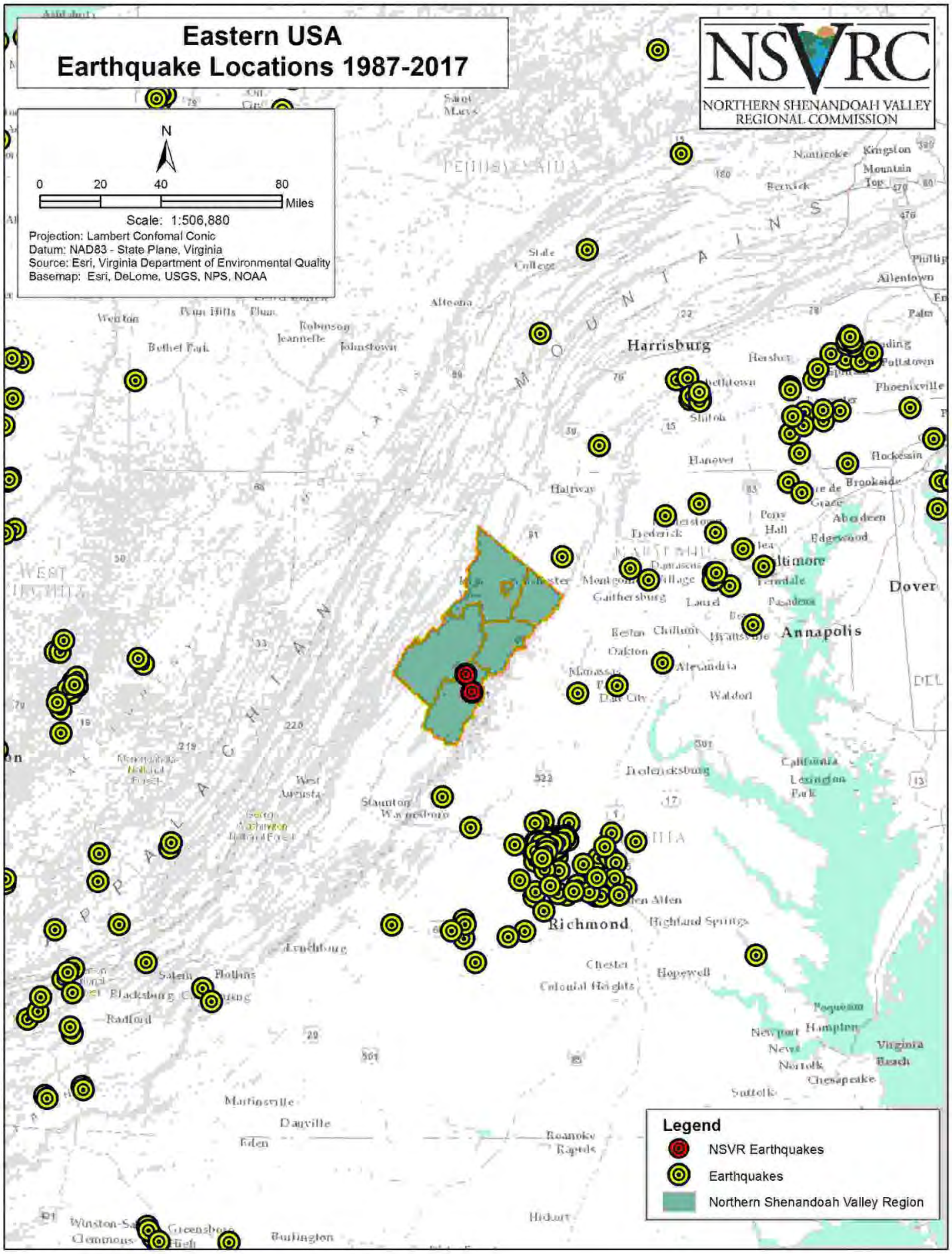


Figure 4.11 –Earthquake Events of the Greater Eastern U.S. - Source: ESRI, FEMA (HAZUS-MH), USGS, NOAA

Most earthquakes occur near plate boundaries, in what are called subduction zones. The nearest plate boundary to the NSV Region is located thousands of miles off the Eastern Coast of the US, thus earthquakes do not strike very frequently in the NSV Region.

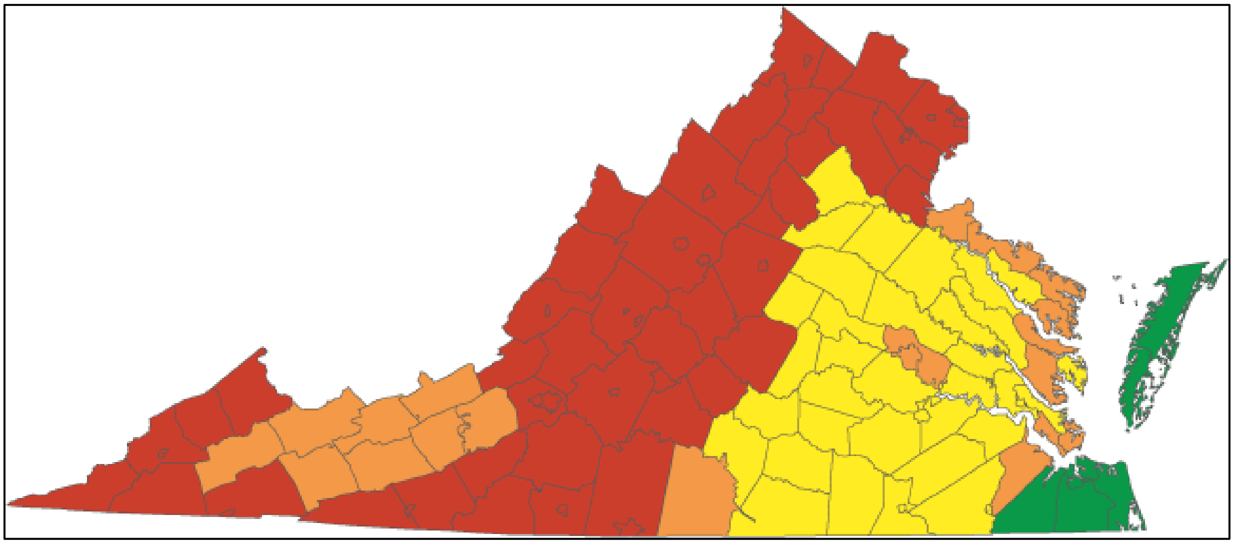
A notable 2011 earthquake near the region was determined to be caused by a weakening tectonic plate along an ancient fault line (accuweahter – 2016). The 5.8 magnitude quake's epicenter was recorded in Louisa County, just southeast of the NSV Region. The earthquake caused extensive damage to buildings and infrastructures, especially to surrounding urban areas, including Washington D.C.

As shown in figure 4.8 and 4.9, two notable earthquakes have stuck the region – one in Luray (2.5 magnitude, 1997) and one in Rileyville (2.4 magnitude, 1998). Both were of about the same magnitude, of which not a whole lot of damage occurs. A 2.5 magnitude earthquake can be felt, but will only cause minor damages.

Future Conditions Analysis – Earthquakes

Figure 4.8 shows the highest concentration of earthquake activity, according to FEMA's HAZUS software, is lcoated north of the City of Richmond - southeast of the NSV Region. Though the historical occurrences have not been very substantial in terms of size/damage, it should be anticipated that earthquakes can cause the upmost types of destruction - including demolished buildings, contaminated water sources, gas leaks, fires and flooding.

Landslide/Steep Slopes



Red = high potential; orange = moderate potential; yellow = moderate to low potential; green = low potential

Figure 4.12 – *Counties in Virginia that are susceptible to landslides.* – Source: USGS

As presented in the 2007 Plan, the areas with the steepest slopes are most prone to impacts from landslides. Future updates to this Plan will quantify impacts to Page County slopes and be used as a model for similar adjacent topographic communities. Several communities have steep slope ordinances which prohibit or limit development on steep slopes. The populations located in jurisdictions with steep slope ordinances are at less of a risk including Clarke County, Town of Front Royal, Shenandoah County, and Frederick County (through a TDR program).

Landslides occur in many manifestations and are usually classified according to the type of material involved and the mode of downslope movement. The material can range from loose earth to blocks of solid rock. These materials may then move downslope by falling, sliding or flowing. The following are some of the more important types of mass movement (VA Department of Mines, Minerals and Energy):

- <u>Rockfalls</u> entail large blocks of bedrock breaking off a cliff face and tumbling downslope.
- <u>Rockslides</u> occur when a detached section of bedrock slides down an inclined surface, frequently along a bedding plane.
- <u>Earthslides</u> involve masses of soil moving down a slip face, usually on top of the bedrock.
- <u>Creep</u> is the slow, continuous, imperceptible downslope movement of soil and rock particles.
- <u>Rotational Slides or Slumps</u> result from the rotation of a cohesive unit of soil or rock down a slip surface, leaving a curved scarp.
- <u>Debris flows</u> develop on steep slopes as a result of heavy rainfall that saturates the soil, which under the extra weight and lubrication breaks loose and becomes slurry that takes everything with it, including large trees and houses. Channeled debris flows can reach speeds approaching a hundred miles an hour and strike without warning.

Future Conditions Analysis – Landslide/Steep Slopes

The potential for landslides in most of the counties in western Virginia is high. As shown in Figure 4.12 - *Counties in Virginia that are susceptible to landslides*, adapted from USGS Landslide Overview Map of the Conterminous United States, at least half of the Commonwealth falls into zones of high (red) potential. Due to the mountainous nature of the NSV Region, there is potential for high risk areas throughout the entire region. Populations located along geologic ridges or at the base of steep slopes should take high precaution during extreme weather events, and construction in such areas should be sparse at best.

Erosion

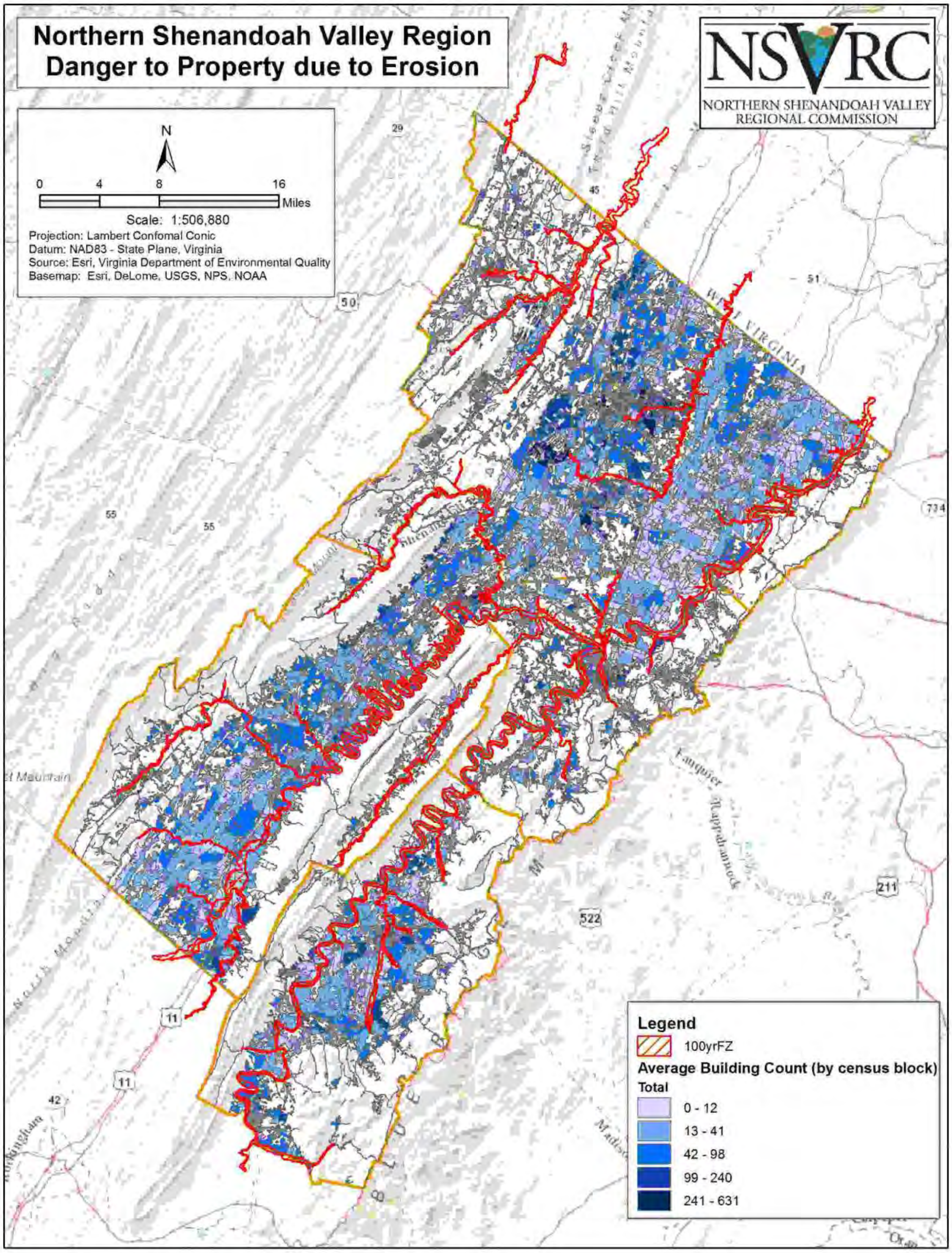


Figure 4.13 – Northern Shenandoah Valley Region Danger to Property Due to Erosion – Source: ESRI, USGS, NOAA

Accelerated erosion is typically caused by surface mining, poorly managed croplands, construction sites, urban/suburban stream banks, and logging roads. Major problems arise when excessive amounts of sediments flow into nearby streams. Excess nitrogen in the soil can cause plant overgrowth that has an adverse effect on the entire surrounding ecosystem.

As a part of the Chesapeake Bay Watershed, the NSV Region's sediment control plays an important role on the overall health of the bay. Problems associated with excess sediment in the watershed and Bay includes (USGS):

- Excessive sedimentation can degrade stream habitat and bury benthic (bottom-dwelling) plants and animals, such as oysters and clams.
- Suspended sediment clouds the water, preventing light from penetrating to the leaves and stems of underwater grasses, or submerged aquatic vegetation (SAV). Suspended sediment and phytoplankton growth due to excess nutrients have reduced water clarity below the thresholds needed to support SAV.
- Toxic materials, potential pathogens, and nutrients may be transported by sediment and contaminate waterways that affect fisheries and other living resources.
- Commercial shipping and recreational boating are threatened by accumulations of sediment that can fill waterways and ports, making traffic difficult or hazardous, and requiring dredging.

Interactive maps are presented on the NSVRC Hazard Mitigation Online Portal, that allow users to zoom into areas of the region, display hydrography, and compare to surrounding elevations, to give an idea of areas of increased risk.

Future Conditions Analysis – Erosion

Erosion vulnerability for the region is difficult to determine because there are no historical records for previous occurrences of erosion events. Vulnerability will be highest among steep slope areas along rivers, creeks and streams. The Shenandoah River and countless tributaries run directly through the NSV Region, populations with direct river and stream access should consider erosion monitoring and mitigations that promote positive stream health and prevent land degradation.

Land Subsidence/Karst Soil

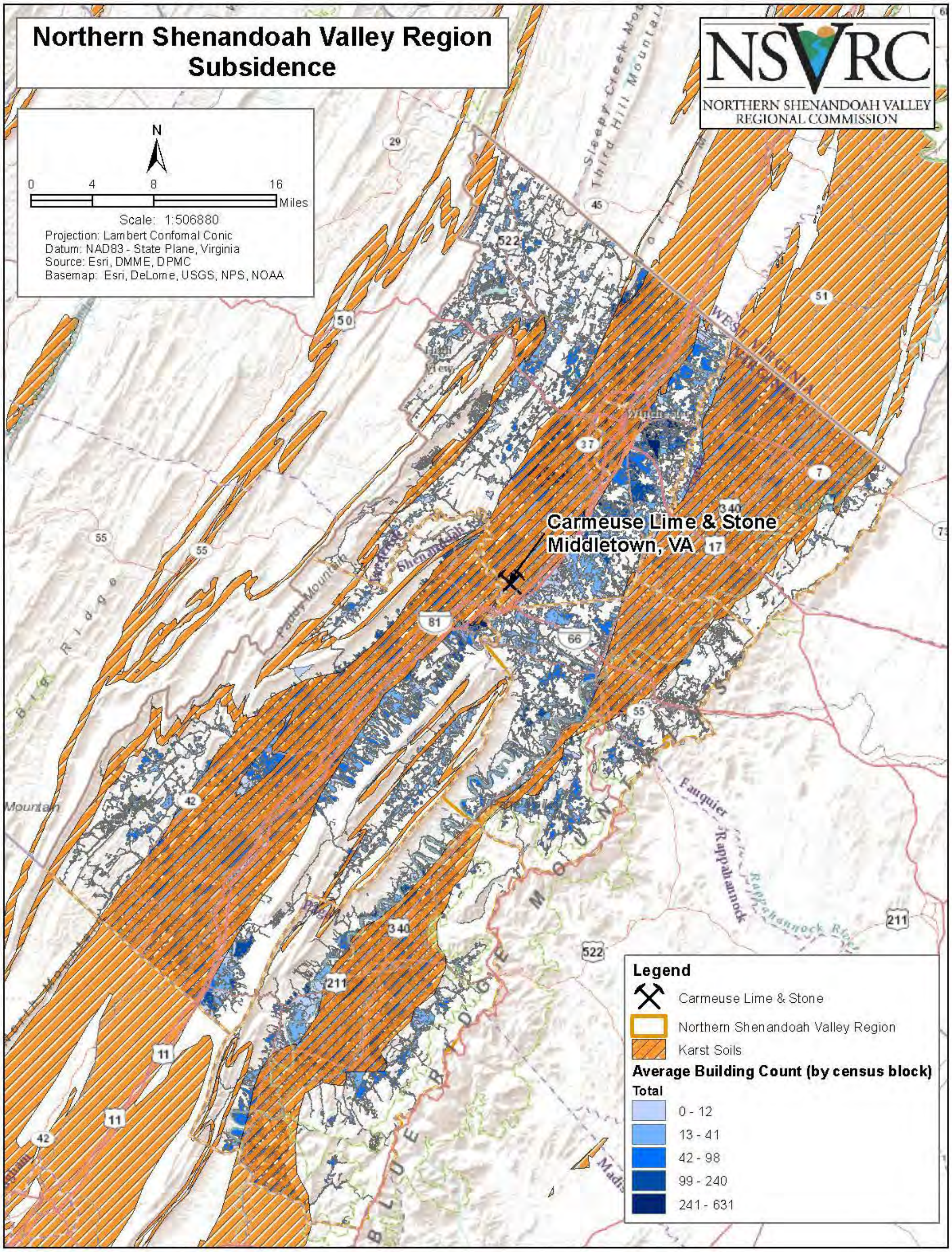


Figure 4.14 – Northern Shenandoah Valley Region Subsidence

Karst is a landform feature created from the dissolved rocks that can take the form of caves, caverns, sinkholes, seeps, springs, disappearing streams, and ponds. 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. According to FEMA, insurance claims for damage resulting from sinkhole formation have increased 1,200% from 1987 to 1991, costing nearly $100 million.

The collapse of land in the karst topography creates sinkholes. Sinkholes are classified as natural depressions of the land surface and are caused when the acidic groundwater dissolves the surrounding geology. Most of these events are triggered by human activity in the karst environment. Excessive pumping of groundwater from karst aquifers may rapidly lower the water table and cause a sudden loss of buoyant forces that stabilize the roofs of cavernous openings. Human-induced changes in surface water flow and infiltration also may cause collapse. Most sinkholes that form suddenly occur where soil that overlies bedrock collapses into the pre-existing void.

Future Conditions Analysis – Land Subsidence/Karst Sol

In Virginia, the principal area affected by sinkholes is the Valley and Ridge province, an extensive karst terrain underlain by limestone and dolomite, but the narrow marble belts in the Piedmont and some shelly beds in the Coastal Plain are also packed with sinkholes. Dramatic collapses that swallow homes or persons have happened in Virginia, but are rare. The most notable incidents occurred in the City of Staunton: on August 11, 1910, parts of several homes and the firehouse were lost in a series of sinkholes on Baldwin Street and Central Avenue, and on October 28, 2001, a 45-feet deep chasm opened up on Lewis Street. In April of 2000, thirty-two sinkholes were reported in the upper Shenandoah Valley after seven inches of rain fell after a long dry spell. (VA Department of Mines, Minerals and Energy)

Mass Evacuations

Mass evacuations from neighboring urban areas, most notably those in the Northern Virginia Region, can cause potential strain or failure to the Northern Shenandoah Valley's transportation, medical, utility, and temporary sheltering infrastructures.

The Virginia Department of Transportation (VDOT) has worked with the localities in and surrounding Northern Virginia to develop incident plans that include evacuation routes. When an event occurs, the Emergency Alert System (EAS) provides the latest information on evacuation. The Northern Shenandoah Valley planning area is divided into two EAS areas (Shenandoah Valley and Winchester).

Northern Shenandoah Valley community emergency operations plans outline the concerns surrounding mass evacuation, in terms of jurisdictional evacuation, evacuation of other areas in which the locality acts as a "host," or as a transit route locale.

Future Conditions Analysis – Mass Evacuations

The City of Winchester and the counties of the Northern Shenandoah Valley region address evacuation in their emergency operations plans, as noted in table 4.5. Some of the localities have detailed evacuation routes in the Warning, Evacuation and Emergency Transportation Annex of their emergency operations plans. The jurisdictions have established traffic control measures and routes to enhance the rate of evacuation and to provide security for evacuated areas, critical facilities, and resources. The emergency operations plans address evacuation from the locality, and touch on the potential impacts caused by a mass evacuation from the Northern Virginia area. The type and scale of event that warrants evacuation from Northern Virginia will drive the type of response the localities will implement. To assist and mitigate against mass evacuation from Northern Virginia, jurisdictions should include additional detail in their plans regarding secondary evacuation routes, the number and location of potential shelters, and what needs the communities foresee as a "host" community.

Table 4.5 - Northern Shenandoah Valley Region Mass Evacuation	
Locality	Mass Evacuation Addressed in EOPs
Clarke County	**Yes**
Berryville	*Included in County EOP*
Boyce	*Included in County EOP*
Frederick County	**Yes**
Middletown	*Included in County EOP*
Stephens City	*Included in County EOP*
Page County	**Yes**
Luray	*Included in County EOP*
Shenandoah	*Included in County EOP*
Stanley	*Included in County EOP*
Shenandoah County	**Yes**
Edinburg	*Included in County EOP*
Mount Jackson	*Included in County EOP*
New Market	*Included in County EOP*
Strasburg	*Included in County EOP*
Toms Brook	*Included in County EOP*
Woodstock	*Included in County EOP*
Warren County	**Yes**
Front Royal	*Included in County EOP*
Winchester City	**Yes**

Table 4.5 – Northern Shenandoah Valley Region Mass Evacuations

Hazard Rankings Process and Results

Hazards were ranked by the Mitigation Steering Committee to determine what hazards they judged to have the largest impact on their communities. The results are summarized in table 4.6, located here and later in this chapter.

Table 4.6 - Northern Shenandoah Valley Region 2018 Hazard Inventory, Rankings and Consideration Levels

Hazard	Type	Ranking/Consideration
Flooding	Riverine	1 - High
Winter Storms/Ice/Extreme Cold	Winter Storm/Ice Storm/Excessive Cold	2 - High
High Wind/Hurricanes	Hurricane	3 - High
Tornadoes	Tornadoes	4 - High
Lightning	Storm	5 - Moderate
Thunderstorm/Hail	Storm	6 - Moderate
Pipelines	Pipelines	7 - Moderate
Mass Evacuation from Northern VA/D.C.	Mass Evacuations	8 - Moderate
Hazardous Materials Spills	Hazardous Material Spills	9 - Moderate
Wildfire	Wildfire	10 - Moderate
Dam Failure/Low Bridges	Dam Safety	11 - Moderate
Extreme Heat	Heat	12 - Moderate
Drought	Heat	13 - Moderate
Earthquakes	Earthquake	14 - Low
Landslide/Steep Slopes	Landslide/Steep Slope	15 - Low
Hail	Storm	16 - Low
Erosion	Landslide/Steep Slope and Karst	17 - Low
Land Subsidence/Karst Soil	Karst	18 - Low

Table 4.6 – Northern Shenandoah Valley Region 2018 Hazard Inventory, Rankings and Consideration Levels

Areas of impact and areas of concern were noted by the committee members through work sessions carried out during update meetings. Interactive hazard maps were reviewed during meetings and were available for reference throughout the planning process. Each locality was given an opportunity to provide input, to the best of their ability, in determining what areas were concerns or "problems" in their communities. The areas indicated by the committee members and the public were taken into consideration during the analysis phase. Individual community problem areas can be better determined through the use of the newly developed NSVRC Hazard Mitigation Portal. Interactive web apps specific to the hazards listed in table 4.6, are all available for public use.

The level of hazard was determined by response from the committee members, local jurisdictions, and the public. Based on the input of committee members the hazard rankings were numerical then divided into four distinct categories (High, Moderate, Low, or None) which represent the level of ranking during this planning process. In order to focus on the most critical, the committee determined hazards assigned a level of Significant / High or Moderate received the most extensive attention in the remainder of the planning process, while those with a Low ranking were assessed in more general terms.

Identifying and Ranking Hazards

The first step, hazard identification presented in table 4.6, identifies all the natural hazards that might affect the planning area. The hazards were subsequently ranked by the Hazard Mitigation Steering Committee to determine what hazards are most likely to impact the communities of NSV Regional Commission. The hazards that are determined to have significant impact are analyzed in the greatest detail to determine the magnitude of future events and the vulnerability of the community and its critical facilities. Hazards that receive a moderate or limited impact ranking are analyzed at a less detailed level consistent with risk, available data and vulnerability methodology.

The risk assessment requirements mandate an overview of the type of all natural hazards that can affect the planning region. The potential hazards likely to occur in the NSV Region pose impacts equally to the communities businesses, governments, and environment. This is due to the geological, geographical, and meteorological ubiquities across the region. To determine the hazards that pose the greatest threat, the following data sets were reviewed and evaluated: the Virginia State Hazard Mitigation Plan; historical data on events that have occurred both regionally and throughout Virginia; the 2012 NSV Regional Hazard Mitigation Plan data; data collected from collaboration with various agencies (including Department of Mines Minerals and Energy and Department of Conservation and Recreation, the Department of Transportation, Department of Environmental Quality, and Department of Forestry); hazards identified in guidance materials provided by FEMA Region III; and other regional mitigation plans of jurisdictions located within Virginia. The approved updates were used to assess the impacts of the hazards.

The list of hazards in table 4.6, was identified by the steering committee in terms of threats to recovery, as well as capacity to respond to a hazard. The ranking methodology included a survey poll issued to the localities and responses collected by NSVRC staff and summaries reviewed by the steering committee. It also involved analysis of GIS mapping, including interactive maps presented on the NSVRC Hazard Mitigation online portal.

The mandated Hazard Identification Risk Assessment (HIRA) section of this chapter was conducted using various methods based on available data. The HIRA is listed separately for each hazard type and includes an assessment of impacts on critical facilities, estimated losses to facilities, and vulnerability to the hazard based on the history of such hazards. The 2012 Plan served as a baseline for the HIRA and is updated herein. The risk assessment includes a description of the jurisdiction's vulnerability to the hazards identified, including a summary of each hazard and its impact on the community.

Unless otherwise stated, each hazard is anticipated to affect the region with the same likelihood of impact and each locality is considered to be equally vulnerable to the natural hazard. Vulnerability includes the following based on availability of data and guidance from the hazard mitigation steering committee:

- The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas
- An estimate of the potential dollar losses to vulnerable structures identified in this section and a description of the methodology used to prepare the estimate
- An estimate of the likelihood of risk to a locality from a hazard based on the general description of land uses and development trends within the community

Critical Facilities Risk Analysis

Using best data available, the planning steering committee derived the inventory of critical facilities presented in chapter 3 of this Plan. Detailed maps can be found in the Regional Setting profile, as well as the appendix of this Plan.

Major Disasters

The declared disasters list at the beginning of this chapter reveals the major disasters that have occurred in the planning area over the past seventy-five years, including Presidentially-declared disasters. Communities in the Northern Shenandoah Valley have received 17 Presidential Disaster Declarations since 1972.

Level of Hazard

Table 4.5 provides information on the types of analysis and data used for each of the hazards addressed in this plan. The level of planning consideration given to each hazard was determined by the committee members. Based on the input of committee members at the kick-off meeting, the hazards were broken into four distinct categories (Significant, Moderate, Limited, or None) which represent the level of consideration they will receive throughout the planning process.

In order to focus on the most critical hazards that may affect the Planning District communities, hazards assigned a level of *Significant* or *Moderate* received the most extensive attention in the remainder of the planning analysis, while those with a *Low* planning consideration level were assessed in more general terms.

Table 4.6 - Northern Shenandoah Valley Region 2018 Hazard Inventory, Rankings and Consideration Levels		
Hazard	**Type**	**Ranking/Consideration**
Flooding	Riverine	1 - High
Winter Storms/Ice/Extreme Cold	Winter Storm/Ice Storm/Excessive Cold	2 - High
High Wind/Hurricanes	Hurricane	3 - High
Tornadoes	Tornadoes	4 - High
Lightning	Storm	5 - Moderate
Thunderstorm/Hail	Storm	6 - Moderate
Pipelines	Pipelines	7 - Moderate
Mass Evacuation from Northern VA/D.C.	Mass Evacuations	8 - Moderate
Hazardous Materials Spills	Hazardous Material Spills	9 - Moderate
Wildfire	Wildfire	10 - Moderate
Dam Failure/Low Bridges	Dam Safety	11 - Moderate
Extreme Heat	Heat	12 - Moderate
Drought	Heat	13 - Moderate
Earthquakes	Earthquake	14 - Low
Landslide/Steep Slopes	Landslide/Steep Slope	15 - Low
Hail	Storm	16 - Low
Erosion	Landslide/Steep Slope and Karst	17 - Low
Land Subsidence/Karst Soil	Karst	18 - Low

Table 4.6 – Northern Shenandoah Valley Region 2018 Hazard Inventory, Rankings and Consideration Levels

Chapter 5: Capability Assessment

Capability is the capacity to carry out projects and policies designed to reduce future impacts from hazards. This includes the resiliency of the locality to respond to a hazard as well as resources and political will to implement policies and programs to strengthen hazard mitigation actions and implement strategies identified in this Plan. The NSV Region's capability assessment was conducted to identify the ability and capacity of participating localities to develop and implement the full suite of hazard mitigation strategies. Outcomes of this assessment are to establish policies and programs, implemented through various projects and actions that reduce future impacts from hazards. The capability assessment determines the feasibility of achieving goals and strategies set forth in this Plan, based on the political and organizational structure of the localities, agencies, and departments responsible for implementation of the policies and programs.

The capability assessment was conducted through a review and inventory of the following from each locality in the planning region: relevant ordinances, comprehensive plans, capital improvement programs, and other programs and policies to identify strengths and weaknesses that might preclude the implementation of hazard mitigation actions and goals. The results of the inventory were reviewed and evaluated to make a determination on the sufficiency of jurisdiction's resources to implement effective hazard mitigation and its resiliency to respond to current and anticipated hazards. In addition, beneficial programs were noted for continued support and enhancement. This is particularly noteworthy with the regional collaborative nature that has been demonstrated among emergency response coordinators in the NSV region in emergency response and hazard mitigation efforts.

The capability assessment helped drive and refine the appropriate mitigation actions identified in this Plan, and provide a roadmap for strengthening the capacity to implement the mitigation strategies to ensure the Hazard Mitigation goals listed in this Plan are realistically achieved.

For the 2018 plan update, the Hazard Mitigation Committee and NSVRC staff reviewed and revised the inventory of local plans, regulations and ordinances developed in the 2012 Hazard Mitigation Plan. These include but were not limited to 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. Factors that influenced capacity assessment were based on reviews of plans, codes, and staff, as summarized in Table 5.1.

Locality	Comprehensive Plan	EOP	Staff Resources	CIP	Municipal Code
Clarke County	x	x	Staff, Planning, Emergency Management, Zoning, Stormwater	CIP, Budget	x
Berryville		Through County	Staff Planning & zoning, Emergency Management	Budget	x
Boyce	x	Through County	Limited	Budget	x
Frederick County	x	x	Staff, Planning, Emergency Management, Zoning, Stormwater	CIP, Budget	x
Middletown		Through County	Clerk, Zoning, Limited Staff	Budget	x
Stephens City	x	Through County	Staff of Planner	Budget	x
Page County	x	x	Emergency Management Staff	Budget	x
Luray	x (Town Plan)	Through County	Planning, Zoning, Assistant town manager	Budget	x
Shenandoah	Economic Development Plan	Through County	Staff	Budget and Revitalization Fund	x
Stanley		Through County	Emergency Management Staff	Budget	x
Shenandoah County	x	x	Emergency Management, Stormwater, planning and Zoning	CIP, Budget	x
Edinburg		Through County	Staff	Budget	x
Mount Jackson		Through County	Staff	Budget	x
New Market	x	x	Emergency Management, Stormwater, planning and Zoning	CIP, Budget	x
Strasburg		Through County	Staff	Budget	x
Toms Brook		Through County	Limited, Staff planning through NSVRC	Budget	x
Woodstock		Through County	Staff	Budget	x
Warren County	x	x	Emergency Management, Stormwater, planning and Zoning	CIP, Budget	x
Front Royal	x	x	Emergency Management also through County, Stormwater, planning and Zoning	CIP, Budget	x
Winchester city	x	x	Emergency Management, Stormwater, planning and Zoning	CIP, Budget	x

Table 5.1 – Northern Shenandoah Valley Region Capacity of Plans

Participating jurisdictions were also given the opportunity to provide additional information for the capability assessment through meetings convened to discuss needs and abilities to carry out the proposed goals. Inquiries to localities prompted discussion and identification of a locality's regulatory capabilities, staff (administrative and technical resources), fiscal resources, the resiliency and capacity to respond to hazards and implement new policies and programs and overall local governments political will implement the mitigation actions based on NSVRC experience from other regional and local planning programs.

The results are presented in five groups of capability to implement including: emergency management; floodplain management; fiscal capability; staff resources; and planning and regulatory capability.

Emergency Management

Various plans including the Emergency Operational Plans (EOPs), pandemic flu response plans, 2012 Hazard Mitigation Plan, fire codes, and other plans and codes were reviewed. This included detailed responsibilities and procedures to be followed to deploy resources in response to an emergency, disaster, or hazard. Each of the five Counties and the City maintain and implement their own EOP. In many cases the Towns are included in the EOPs for the Counties in which they are located; this is the case in part throughout the region and in full for Shenandoah County and its six Towns and also for Clarke County and its two Towns. Overall findings in this assessment are that each jurisdiction, either through its overarching County, or individually, has sufficient capabilities in emergency management. Areas for improvement (such as warning systems, etc., are noted in mitigation strategies).

Floodplain Management

Each of the jurisdictions mentioned in this plan, participate in the NFIP program and plan to maintain continual compliance. However, the town of Boyce is lacking floodplain maps and will address this issue as an item of plan maintenance. Existing plans, ordinances and programs were evaluated including national flood insurance programs (NFIP) such as the Community Rating System (CRS), flood overlay protective districts (and ordinances), wetland protection plans, and other flood damage prevention ordinances. Locality and regional 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 rating and through participation receive flood insurance premium rates discounted in increments of 5% according to CRS class designation. The CRS classes for local communities are based on 18 creditable activities, organized under four categories:

1. **Public Information**
    - Elevation Certificates
    - Map Information Service
    - Outreach Projects
    - Hazard Disclosure
    - Flood Protection Information
    - Flood Protection Assistance
2. **Mapping and Regulations**
    - Additional Flood Data
    - Open Space Preservation
    - Higher Regulatory Standards
    - Flood Data Maintenance
    - Stormwater Management
3. **Flood Damage Reduction**
    - Floodplain Management Planning
    - Acquisition and Relocation
    - Flood Protection
    - Drainage System Maintenance
4. **Flood Preparedness**
    - Flood Warning Program
    - Levee Safety
    - Dam Safety

This capability area was considered sufficient with respect to the presence of an active regional floodplain manager although there were areas identified to improve the capacities based on findings from this assessment including a community rating system and reduction in the number of houses on the repetitive properties list. There are currently no localities in the NSV planning region that are enrolled in the CRS program; however, efforts are underway to initiate the CRS program in the region. The need for a regional or local enrollment in the CRS was included in the regional mitigation strategies as an outcome of this assessment. The September 2012 steering committee hosted the Virginia CRS locality representative for the committee to consider CRS membership as a region and how to best advance recommendations to the planning staff of the localities.

The recent stormwater regulatory program, being administered through the VA Department of Conservation and Recreation, mandates each locality have an adopted stormwater program and ordinance by July 2014. In 2012, the Counties and the City commenced developing a draft stormwater ordinance for their Council and Board consideration in 2013. Regionally, localities are initiating efforts to develop policies and programs to implement a stormwater program to conform to state code. This ongoing effort will enhance the local and regional capability of floodplain management.

Another area of weakness in capability assessment finding under the category of floodplains is the quantity of repetitive loss properties and a mechanism to raise awareness to localities about opportunities to elevate, dry flood-proof, or relocate and acquire such properties. Additional steps needed were identified to help localities with better understanding opportunities to reduce the list of repetitive loss properties. This area for enhancement is reflected in a regional strategy to reduce repetitive loss properties through abatement or acquisition.

Fiscal Capability

Capital Improvement Plans were inventoried and comprehensive land use plans and other plans were evaluated. Public funds invested in hazard mitigation improvements to the benefit of life and property within the region are important components of capability. In addition, having the resources to assert the priority projects and programs for capital improvements and the staff needed to obtain funding to implement these projects are also critical. Results of the capability assessment indicated a need for increased fiscal resources dedicated to implement the hazard mitigation strategies. This Plan serves as a roadmap for localities to use to identify projects when funding opportunities become available. The Plan Maintenance section of this Hazard Mitigation Plan provides localities and NSVRC with a framework to evaluate progress on strategy implementation of hazard mitigation strategies and advancement of projects for grant funding.

Staff Resources

This included a review of in-house staff for administrative and technical support. Findings from this assessment indicated a need for additional administrative and technical staff for some localities. Most localities in the region have one or more designated emergency service managers with clearly defined responsibilities. In Shenandoah and Page Counties the regional emergency manager assumes the responsibility for the Towns located within the County, where Town staff is limited. Where localities are limited in staff resources, the NSVRC or other service providers offer support to help these localities meet the letter and spirit of the hazard mitigation goals and strategies. For example, the Town of Toms Brook had a planning consultant to assist the Town. In July 2012, this role was assumed by the NSVRC staff in the preparation of a comprehensive land use plan and to provide additional planning services to the Town. Based on regional support, this capability was considered sufficient. A regional strategy in the future could be identification and pursuit of planning grant funding opportunities to support additional hazard mitigation planning efforts of the localities in the region. This type of strategy could enhance the capability of staff resources.

Planning and Regulatory Capability

Planning and regulatory capability is demonstrated by the development and implementation of plans, ordinances, programs, and policies by a locality 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. In addition, protection of environmental resources demonstrates capability to improve resiliency of the natural resources to recover from hazards. This assessment included an overview of the key planning and regulatory tools and programs in place, or currently underway, in the jurisdiction and throughout the region. This capability was determined sufficient in terms of the presence of planning tools with the exception of several Towns lacking a comprehensive land use plan. The staff resource category findings and recommended strategies for increased planning support for all localities through application of additional planning grants could facilitate this capability to be uniformly strong throughout the region.

Other areas identified to improve or enhance capabilities through planning and regulations are ensuring continuity and coordination of hazard mitigation strategies with other regional and local plans and programs. For example, localities could include a strategy to ensure plan consistency between hazard mitigation strategies and other planning efforts such as community development plans covering property acquisition or violation abatement; bridge improvements in transportation programs; and stormwater detention basin upgrades under the Chesapeake Bay TMDL watershed implementation plan.

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. The plans and ordinances reviewed include: disaster recovery plans, comprehensive land use plans, stormwater management plans, fire codes, building codes, historic preservation plan, zoning ordinances, building codes, and subdivision codes. This portion of the assessment aggregated the result from all five groups to help identify the capabilities within the planning region.

Overall the assessment resulted in the identification of these areas for continued improvement:

- continue to encourage and enhance regional and local emergency management;
- update database gaps in floodplain maps and encourage floodplain management through policies and projects;
- improve fiscal capability and implement mitigation strategies identified in this Plan to fund when grant opportunities arise;
- increase local staff resources at the local level and through regional support; and, develop (continue to develop) a comprehensive planning and regulatory program in each locality to improve capability.

Chapter 6: Mitigation Strategies

This mandated portion of the Plan provides localities with the platform from which to identify actions and programs to implement to reduce impacts of identified hazards. Based on the findings of the Hazard Identification and Risk Assessment (Chapter 4) and the Capability Assessment (Chapter 5), this Chapter includes the mission statement, goals and actions. Components of the Mitigation Strategy include:

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

This NSV Regional Hazard Mitigation Plan 2018 update includes a review of hazards and focuses policies, programs, and projects that will reduce future impacts from hazards while achieving compatible economic, environmental, and socio-political goals. In addition, the Mitigation Action Sub-Plan subsection herein identifies policies, projects, responsible entities and agencies to reduce effects from hazards and protect life and property. In addition, funding sources are identified as information is available. The Mitigation Action Sub-Plan is a sub-plan within this Plan and includes a spreadsheet format in the 2012 NSV Regional Hazard Mitigation Plan and lists specific strategies and projects, 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. Each hazard type (flooding, winter storm, non-rotational wind, etc.) was evaluated by localities in terms of impacts, ability to recover, capacity to respond to and potential to mitigate effects of (see results presented in previous chapters of this Plan) each hazard while meeting the goals listed below.

Once and strategies were identified, similar ones were aggregated and applied to the region. Below is the approach to provide the framework for the strategy identification process. Following the mission statement and goals, this chapter provides a summary of the local and regional strategies. The mitigation strategies with tracking information are provided in the strategy section.

These mitigation strategies were collaboratively prepared by the steering committee and individual jurisdictions using the strategies from the 2012 Plan, the State Hazard Mitigation Plan, and experience and desires of the planning team. These mitigation strategies provide the participating jurisdictions' blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs, and resources, and ability to expand on and improve these existing tools. A thorough review was conducted of all jurisdictional comprehensive plans, budgets, and working knowledge of staff resources, to assess the capacity to implement the strategies. Interviews were conducted with jurisdictions' staff involved in local planning, public works, and emergency management in order to assess the feasibility of a mitigation strategy and identify the best means to implement it. Reviews of jurisdictional budgets, comprehensive plans, building codes, and ordinances were likewise consulted in this Plan update.

The value of the strategies is to also provide an outline for a jurisdiction to apply for funds to implement strategies and thereby reduce impacts from natural disasters. The annual review of the Plan and evaluation of strategies will be updated and revised as the jurisdiction and planning team determine needed. In addition, a series of goals were identified in the 2012 Plan and revised and updated herein to help implement the mitigation strategies and reduce or avoid long-term vulnerabilities to the natural hazards identified.

This Plan includes a section dedicated to a Mitigation Action Sub-Plan that adheres to conventional planning with a mission statement, goals, and mitigation actions to reduce the impacts of future hazard events. The Hazard Mitigation Steering Committee worked with NSVRC staff to guide the process. NSVRC staff held a series of meetings with localities (County-Town meetings) to facilitate the identification of key priority projects and policies to reduce impacts to life and property from hazards. The Steering Committee reviewed and helped develop regional preferences from the prioritized actions (policies, programs, and projects).

Each step in the Mitigation Action Sub-Plan 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, goals to meet the mission statement, strategies to implement the goals through policies, programs, and projects. The result is prioritized list of policies, programs, and projects, including contacts responsible for implementation, estimated completion date, and potential funding source(s).

The mission statement is:

To reduce the physical and economic impacts from natural hazards on the local governments located within the NSV Region to the benefit of life and property.

The goals to achieve this mission statement provide a framework for the manifestation of the mission statement through policies, programs, and projects. These goals were identified using planning process identified in Chapter 2 of this Plan. These general hazard mitigation goals are broad policy statements that reflect what the jurisdictions seek to accomplish through implementation of the mitigation plan and strategies. The goals are tied directly to reducing the impacts of the hazards identified in this Plan update.

- **Goal #1**: Minimize flood-related deaths and losses of existing and future structures.
- **Goal #2**: Improve and update data needed for hazard mitigation efforts within the NSV Region for localities.
- **Goal #3**: Implement policies that incorporate mitigation planning into the framework of local government in the NSV Region to enhance hazard mitigation.
- **Goal #4**: Identify, prioritize, and implement (a list of) cost effective structural projects throughout the region to reduce the impact of hazards identified in this Plan update and future disaster events.

- **Goal #5**: Offer hazard mitigation and disaster preparedness training to educate local staff and raise public awareness.

- **Goal #6**: Develop educational outreach projects throughout the region to educate the public about the dangers of natural hazards and create a page on the NSVregion.org website for localities and the public.

Based on the goals listed above, the following types of actions were identified. These actions will form the basis for the strategies. These actions have been identified to implement the strategies and achieve the goals in this Plan. These actions include project-specific actions to reduce the effects of hazards and reduce impacts to life and property (both existing and planned buildings and infrastructure). In addition, the problem spots identified in the 2012 Plan were reviewed and considered during the identification of the actions in order to ensure minimizing and or reducing those previously identified "problem spots" as well as for the overall improved resiliency of a jurisdiction to a natural hazard. As presented in the FEMA guidance: mitigation 'actions and projects means a hazard mitigation action, activity or process (for example, adopting a building code) or it can be a physical project (for example, elevating structures or retrofitting critical infrastructure) designed to reduce or eliminate the long term risks from hazards. This can be met with either actions or projects, or a combination of actions and projects.' Strategies, or actions, were developed as a logical extension of the plan's goals. Most of these actions are dynamic and can change. The actions were prioritized for each jurisdiction based on past damages, existing exposure to risk, other community goals, and weaknesses identified by the local government capability assessments. The priorities differ somewhat from jurisdiction to jurisdiction. These actions have been organized into a Mitigation Action Plan for each participating jurisdiction.

The following actions form the basis for the development of mitigation strategies and individual Mitigation Action Plans for each jurisdiction. These goals and actions apply to the region and the individual jurisdictions.

Goal A - Community Awareness

1. Encourage leadership within the public and private sector organizations to prioritize and implement local, County, and regional hazard mitigation activities as a public value.
2. Establish cooperative relationships between the public, private, and non-profit sectors to enhance our preparedness, response, recovery, and mitigation for hazard events.
3. Support pre-disaster mitigation and remedial efforts, should damage from a natural hazard event occur.
4. Introduce hazard awareness and risk reduction principles into the community's daily activities, processes, and functions.
5. Develop and implement education and outreach programs to increase public awareness of the risks associated with natural and manmade hazards.
6. Improve community education and communication as they relate to disaster.

Goal B - Local Capacity

1. Assess the extent of our vulnerability to natural and man-made environmental hazards.
2. Enhance the capabilities of local government to lessen the impacts of future disasters.
3. Improve hazard assessment information to make recommendation to discourage new development (and encourage preventative measures for existing development) in areas vulnerable to natural and man-made hazards.
4. Leverage additional federal, non-federal, and state resources in meeting natural disaster resistance goals.
5. Encourage scientific study of natural and man-made hazards and the development of data to support mitigation strategies for those hazards that are a threat to the region and localities within.

Goal C - Property Protection

1. Minimize the impact of natural and man-made hazards on property with the region and localities within and promote future disaster resistant development.
2. Protect new and existing public and private infrastructure and facilities from the effects of natural and man-made hazards.
3. Reduce damage to personal and public property including critical facilities.
4. Identify and protect critical services, buildings, facilities and infrastructure at risk to natural and man-made hazards and undertake cost-effective mitigation measures.

Goal D - Public Safety

1. Enhance the safety of residents and businesses by protecting new and ex1stmg development from the effects of natural and man-made hazards through efficient policies and procedures.
2. Ensure public health and safety within the region and localities within before, during, and following hazardous events.
3. Protect the citizens to the best of our abilities from natural and man-made environmental hazards to reduce the loss of life and personal injury.
4. Create coordinated regional emergency response criteria to establish services through the use of federal, state, regional and local resources utilizing a regional reciprocating agreement.

Mitigation Alternatives

The results of the Hazard Identification and Risk Assessment and the 2012 Plan resulted in the generation of a range of potential mitigation goals and actions to address the hazards. A range of acceptable alternatives were then identified and provided to the steering committee and local jurisdictions during the identification of strategies and consideration of alternatives. When deciding on which strategies should receive priority in implementation, the communities considered:

- Time - Can the strategy be implemented quickly?
- Ease to implement - How easy is the strategy to implement?
- Will it require many financial or staff resources?
- Effectiveness - Will the strategy be highly effective in reducing risk?

- Lifespan -How long will the effects of the strategy be in place?
- Hazards - Does the strategy address a high priority hazard or does it address multiple hazards?
- Post-disaster implementation - Is this strategy easier to implement in a post-disaster environment?

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

On the following pages are the strategies that each jurisdiction developed for their community. The strategies are organized as an action plan and include the following: a priority ranking (high, medium, low based on steering committee and locality rankings); ability to achieve Goals 1-6 and Actions A-D (A.1-A.6; B.1-B.5; C.1-C.4; and D.1-D.4); responsible department; likely source of funding to implement; and target completion date. The Counties and the City of Winchester are presented in alphabetical order followed by the Towns in alphabetical order. As part of the 2012 update of the NSV Regional Hazard Mitigation Plan, the 2012 Plan strategies were reviewed and revised as progress or completion has occurred or needs dictate. Progress achieved on the 2012 mitigation strategies has been through ordinance reviews, floodplain reviews and locality staff interviews.

Action Plan

To implement these strategies listed below, if a Benefit Cost Analysis (BCA) is required, the participating jurisdiction will work with VDEM and NSVRC staff to complete the BCA. Where indicated, the regional strategies are either new or if identified in the 2012 Hazard Mitigation Plan, the status is currently in-progress.

The above regional mitigation strategies are applicable to each of the participating twenty localities. In addition, the Counties and Towns and the City of Winchester have specific strategies which are presented below. The main update to the mitigation strategies for each of the localities, dealt with adjusting the priority and implementation time.

Items listed below with HIGH priority are given an estimated completion date of 1 year after the adoption of the plan. Those listed as a MEDIUM priority, are assigned a 2-3 year period of performance, while the LOW priorities should be completed within 5 years for the adoption of this plan. 2012 Mitigation Strategies can be found in the Appendix of this plan, for the purpose of tracking progress.

Clarke County

Table 6.1 – Clarke County Action Plan to Implement Mitigation Strategies

Mitigation Action	Priority	Clarke County, Town of Berryville, Town of Boyce			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day).	H	All	2 /D.1, D.D.2, D.3, D.4	Communications, Emergency Management/ In progress	VDEM
Conduct public education on the principles of "sheltering in place."	M	All	6 /A.1-A.6	Planning / In progress	VDEM
Educate residents and business owners about reducing possible wind-borne debris (e.g., anchoring storage sheds, moving outdoor furniture indoors, trimming trees).	M	hurricane, Tornado, Severe Storm	5, 6 /A.1-A.6, D.1-D.3	Planning/ In progress	VDEM
Encourage public and private water conservation plans, including consideration of rainwater catchment system.	M	Drought	5, 6 /A.1-A.6, D.1-D.3	Planning/ In progress	VDEM
Work with the Virginia Department of Forestry to implement the FIREWISE program in Clarke County and localities.	M	Wildfires	5, 6 /A.1-A.6, D.1-D.3	Planning/ In progress	VDEM
Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury and or property damage.	H	All	2 /B.1-B.5, D.4	GIS, Planning/ In progress	Locality, VDEM

Table 6.1 – Clarke County Action Plan to Implement Mitigation Strategies *(continued)*

Mitigation Action	Priority	Clarke County, Town of Berryville, Town of Boyce			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Consider providing necessary electrical hook-up, wiring, and switches to allow readily accessible connections to emergency generators at key critical public facilities.	M	All	4 /C.1-C.4, D.1-D.4	Emergency Management/ In progress	VDEM
Link structure value data with tax parcel GIS database to increase accuracy of loss estimates	M	All	1, 2 /C.1-C.4, D.1-D.4	GIS, Planning/ In progress	VDEM
Encourage purchase of NOAA radios. Provide NOAA weather radios to public facilities.	H	All	2 /D.1, D.D.2, D.3, D.4	Communications, Emergency Management/ In progress	VDEM
Investigate critical community facilities, such as County administrative offices, shelters (non-school buildings), fire stations and police stations, to evaluate their resistance to flood and wind hazards.	H	Flood, hurricane, Tornado, Severe Storm	1,2, 4 /B.1-B.6, C.1-C.4, D.1-D.4	Emergency Management/ In progress	VDEM
Prioritize facilities in known hazard areas (e.g., floodplains). Acquire, remediate, elevate repetitive loss properties	H	Flood	1, 4/C.1-C.4, D.1-D.4	Emergency Management/ In progress	VDEM
Identify program of corrective actions to improve stormwater systems' capacity to handle major rain events.	L	Flood	1, 3/B.3-B.5, D.1, D.2	Planning/ In progress	Locality, VDEM
Investigate, develop, or enhance Reverse 911 system or other public notification system.	H	All	5, 6 /A.1, A.5, D.1-D.4	Emergency Management/ In progress	VDEM
Continue to enforce zoning and building codes to prevent/control construction within the floodplain.	M	Flood	3 /B.1 -B.2, C.2, D.1	Planning/ In progress	Locality
Identify and protect critical recharge HRZ	M	Flood	3 /B.2	Planning/ In progress	Locality

Table 6.1 – Clarke County Action Plan to Implement Mitigation Strategies *(continued)*

Mitigation Action	Priority	Clarke County, Town of Berryville, Town of Boyce			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Work with the Virginia Department of Forestry to review local zoning and subdivision ordinances to identify areas to include wildfire.	L	Wildfires	3 /B.2	Planning, Emergency Management/ In progress	Locality, DOF, VDEM
Work with mobile home parks to construct community wind shelters or to identify and publicize nearby shelters for residents.	L	Hurricane, Tornados, Storms, Snow	5, 6 /A.1-A.6, D.1-D.4	Planning, Emergency Management/ In progress	VDEM
Inspect and clear debris from stormwater drainage system. Encourage VDOT to execute this strategy if needed.	L	Flood, hurricane, Tornado, Severe Storm, Snow, Ice, Landslide	2, 4 /C.2, D.1-D.4	Emergency Management/ In progress	VDEM, VDOT

Table 6.1 – Clarke County Action Plan to Implement Mitigation Strategies

Frederick County

Table 6.2 – Frederick County Action Plan to Implement Mitigation Strategies

Mitigation Action	Priority	Frederick County, Town of Middletown, Town of Stephen City			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Conduct public education on the principles of "sheltering in place."	M	All	6 /A.1-A.6	Planning/ In progress	VDEM
Identify and educate homeowners in flood-prone areas about flood insurance and floodplain mitigation measures.	H	All	2 /D.1, D.D.2, D.3, D.4	Emergency Management/ In progress	VDEM
Work with the Virginia Department of Forestry to implement the FIREWISE program in County and Towns.	M	Wildfires	5, 6 /A.1-A.6, D.1-D.3	Planning/ In progress	VDEM
Conduct emergency preparedness education campaign targeted at residents and business within dam inundation zones.	H	Dam Safety, Flood	1, 2, 4 /A.1-A.6, D.1-D.4	Emergency Management/ In progress	VDEM
Work with local home improvement stores to provide workshops to residents on mitigation techniques.	M	ALL	5, 6 /A.1-A.6	Emergency Management/ In progress	VDEM
Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day).	H	All	2 /D.1, D.D.2, D.3, D.4	Emergency Management / In progress	VDEM
Work with the National Weather Service to promote the Turn Around, Don't Drown public education campaign.	M	Flood	5, 6 /A.1 -A.6, B.2	Emergency Management/ In progress	VDEM, Locality
Develop flu annex for continuity of operations plans.	L	All	3 / D.1	Emergency Management/ In progress	Locality, VDH

Table 6.2 – Frederick County Action Plan to Implement Mitigation Strategies *(continued)*

Mitigation Action	Priority	Frederick County, Town of Middletown, Town of Stephen City			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Develop debris management plan.	M	Flood, Storms, Snow, Ice, Hurricane	1, 5 /C.1-C.4, D.1-D.4	Emergency Management/ In progress	VDEM, Locality
Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury and or property damage.	H	All	1, 2 /C.1-C.4, D.1-D.4	GIS, Emergency Management/ In progress	Locality, VDEM
Identify training opportunities for staff to enhance their ability to use GIS for emergency management needs.	M	All	1, 2 /C.1-C.4, D.1-D.4	GIS, Emergency Management/ In progress	Locality
Investigate all primary and secondary schools to evaluate their resistance to all natural hazards. Prioritize the schools that are used as community shelters.	H	All	All	Emergency Management/ In progress	Locality, VDEM
Investigate critical community facilities, such as County administrative offices, shelters (non-school buildings), fire stations and police stations, to evaluate their resistance to flood and wind hazards.	H	All	All	Emergency Management/ In progress	Locality, VDEM
Prioritize facilities in known hazard areas (e.g., floodplains).	M	Flood	1,4 /C.1-C.4, D.1	Emergency Management/ In progress	Locality
Link structure value data with tax parcel GIS database to increase accuracy of loss estimates.	M	All	1, 2 /C.1-C.4, D.1-D.4	GIS, Emergency Management/ In progress	Locality
Review and revise, if needed, existing Subdivision Ordinances to include hazard mitigation-related development criteria in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.	M	All	3 /B.2	Planning/ In progress	Locality
Review and revise, if needed, local floodplain ordinances. Work with the state to coordinate a Community Assistance Visit to identify potential improvements or enhancements to existing floodplain management program.	H	Flood	3 /B.2	Emergency Management with Planning/ In progress	Locality

Table 6.2 – Frederick County Action Plan to Implement Mitigation Strategies *(continued)*

Mitigation Action	Priority	Frederick County, Town of Middletown, Town of Stephen City			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Encourage purchase of NOAA radios. Provide NOAA weather radios to public facilities.	**H**	All	All	Emergency Management/ In progress	VDEM
Increase flood warning capabilities, particularly as they relate to dam failure.	**H**	Flood, Dam Safety	1, 2, 4, 5 /B.1-B.5, D.1-D.4	Emergency Management/ In progress	Locality, VDEM and DCR for infrastructure
Investigate, develop, or enhance Reverse 911 system or other public notification system. Investigate possible funding sources.	**H**	All	All	Emergency Management/ In progress	Locality and VDEM

Table 6.2 – Frederick County Action Plan to Implement Mitigation Strategies

Page County

Table 6.3 – Page County Action Plan to Implement Mitigation Strategies					
Mitigation Action	Priority	Page County, Town of Luray, Town of Shenandoah, Town of Stanley			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g. hurricane preparedness week, winter	**H**	All	All	Communications, Emergency Management / In progress	VDEM
Create a multi-level education brochure and program that would be taught on different levels with regards to education within the school system as well as targeting a brochure for the residents throughout the county.	**L (Changed from H)**	All	1, 6 /A.1-A.6, D.1-D.4	Communications, Emergency Management / In progress	VDEM
Create informational flyer to be handed out at the time of building permits are applied for with regard to building weather resistant homes. This flyer would be targeted to contractors and developers in a way to enhance their building project.	**H**	All	6 /A.1-A.6, D.1-D.4	Emergency Management/ In progress	VDEM
Identify need for Back-Up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfalls identified.	**H**	All	4 / C.1-C.4, D.1-D.4	Emergency Management/ In progress	VDEM
Procure and install backup generators for lift stations for wastewater treatment plants throughout the region	**H**	All	1,4/ C.1-4, D.1-4	Emergency Management	VDEM
Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FIRMs).	**H**	Floods	1/B.1-B.5	Emergency Management/ In progress or initiated (completed in Luray)	VDEM
Install additional Iflows in rivers throughout the region and update the digital readouts to facilitate transfer of data (analog updates)	**H**	Floods	1 / C.2, D.1-D.4	Emergency Management/ In progress or initiated	VDEM, USGS
Encourage public and private water conservation plans, including consideration of rainwater catchment system or other low impact development techniques.	**H**	All	3 / B.1-B.5	Emergency management or Town staff. In progress for all, completed in progress for all, completed in Luray and Stanley.	VDEM

Table 6.3 – Page County Action Plan to Implement Mitigation Strategies *(continued)*

Mitigation Action	Priority	Page County, Town of Luray, Town of Shenandoah, Town of Stanley			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Inspect and clear debris from stormwater drainage system. Encourage VDOT to execute this strategy if needed. Maintain bridges yearly.	H	All	4 / C.1-C.4, D.1-D.4	Emergency management, County and all Towns but Luray work with VDOT (Luray complete with Town staff) / In progress	VDEM, VDOT
Initiate discussions with public/private utility companies to discuss incorporating mitigation measures into new and pre-existing development and infrastructure repairs. Options include: anchoring heavy equipment such as electrical transformers mounted on poles using additional straps and braces; reducing camber in overhead transmission lines; and providing cover for exposed utilities.	L	All	4 /D.1-D.4	Emergency Management, Town staff / In progress	VDEM, Public Utilities
Evaluate properties within the floodplain for possible relocation and/or buy out. In particular, target FEMA's Repetitive Loss Properties throughout the Page Valley for possible relocation and/or buy out.	H	Flood	1,4 /C.1-C.4, D.1-D.4	Emergency Management, Town staff / In progress	VDEM
Work with land trusts to facilitate purchase of land.	H	All	All	Emergency Management, Town/In progress	VDEM, Valley Conservation Council, land trusts
Implement a program to seal and vent or raise sewer system components (i.e. manhole covers that are located in the 100-year floodplain or other areas identified as highly probable flooding).	H	All	4 / D.1-D.4	Emergency management, County and all Towns but Luray work with VDOT (Luray complete with Town staff)./ In progress	VDEM, VDOT
Integrate the jurisdiction's mitigation plan into current capital improvement plans to ensure that development does not encroach on known hazard areas.	L	All	3 / A.1-A.6, B.1-B.3	Emergency Management, Town staff / In progress	VDEM

Table 6.3 – Page County Action Plan to Implement Mitigation Strategies *(continued)*					
Mitigation Action	**Priority**	**Page County, Town of Luray, Town of Shenandoah, Town of Stanley**			
		Hazard(s)	**Goals (1-6)/ Actions (A-D)**	**Responsible Dept/ Status**	**Funding Source**
Investigate all primary and secondary schools to evaluate their resistance to all natural hazards. Prioritize the schools that are used as community shelters.	**L**	All	5,6 /A.1-A.6, D.1-D.4	Emergency Management, Town staff / In progress	VDEM
Link structure value data with tax parcel GIS database to increase accuracy of loss estimates.	**L**	All	2 / B.1-B.5	Emergency Management work with GIS and Town Staff	VDEM
Establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood-prone areas. Work with VDOT and other jurisdictions as needed.	**H**			Emergency Management, Planning Staff/ In progress	Localities, VDEM
Staff Emergency Management Office, Public Works, Building Inspections Office and/or Planning and Zoning Office at adequate levels as determined by the county based upon population demographics with regard to density and hazardous risks.	**M**	All	5 / B.1-B.4	Emergency Management, Planning Staff/ In progress	Localities, VDEM
Work with the Department of Forestry to implement the FIREWISE program in Page County.	**M**	Fire	5,6 / A. 1-A.6, D.1-D.4	Emergency Management, Town Staff / In progress	VDEM, DOF
Ensure all localities within the planning region have FiRM flood maps up to date	**H**	Flood	1, 2 /B.1-B.4	GIS, Planning/ In progress	VDEM
Work with localities to improve documentation of flooding events and impacts to transportation routes.	**H**	Floods, Storms, Snow, Hurricane, Tornado	1,2,4 /A.3,A.5,B.1-B.4, C.1-4, D.1-4	Emergency Management, Transportation Planning (as available) / In progress	VDEM
The County will consider participating in the StormReady Program sponsored by the National Weather Service.	**L**	Thunder storms, hurricane, tornado, winter storms	5,6/B.1, A.2, A.5, A.6	Emergency Management work with Towns and NWS	VDEM

Table 6.3 – Page County Action Plan to Implement Mitigation Strategies

Shenandoah County

Table 6.4 – Shenandoah County Action Plan to Implement Mitigation Strategies

Mitigation Action	Priority	Shenandoah County, Towns of Edinburg, Mt. Jackson, New Market, Strasburg, Toms Brook, and Woodstock			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Create a Public Education Program within the public and private schools within the community that will provide disaster preparedness information to the student bodies that can be utilized within their individual homes.	H	All	6 /A.1	Emergency Management/ In progress	All Localities
Consider participating in the StormReady program sponsored by the National Weather Service.	M	Storms, Hurricane, Tornado, Winter Storms	5 /A.2	Emergency Management/ In progress	All Localities
Distribute information packets to raise awareness regarding the risks present in the region and to provide disaster preparedness information.	M	All	5, 6 /A.3	Emergency Management/ In progress	All Localities
Create a knowledgeable group of speakers within the community that can be available to present programs regarding Emergency Management Principles and Concepts to groups within the community.	L (County hired PIO staff)	All	5, 6 /A.1- A.6	Emergency Management/ In progress	All Localities
Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day).	L (County hired PIO staff)	All	5, 6 /A.1- A.6	Emergency Management/ In progress	All Localities
Identify need for back-up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfall identified.	H	All	All	Emergency Management/ In progress	VDEM
Develop a comprehensive debris management plan as an annex to the Emergency Operations Plan.	H	All	3, 4 /B.1-B.6, D.1 - D.4	Locality, VDOT/ In progress	Locality, VDOT
Coordinate with FEMA and the state to continue program of updating the community Flood Insurance Rate Maps (FIRMs) for selected tributaries of the North Fork of the Shenandoah River.	H	All	1,4 /B.3, C.1-C.4, D.1-D.4	Emergency Management/ In progress	VDEM
Encourage public and private water conservation plans, including consideration of rainwater catchment systems or other low impact development techniques.	M	Drought	3 /B.4, A.6	Emergency Management/ In progress	All Localities
Incorporate mitigation principles into local emergency management and recovery plans.	M	All	All	Emergency Management/ In progress	VDEM, Planning staff (as available)

Table 6.4 – Shenandoah County Action Plan to Implement Mitigation Strategies *(continued)*					
		Shenandoah Co., Edinburg, Mt. Jackson, New Market, Strasburg, Toms Brook, Woodstock			
Mitigation Action	Priority	Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Provide training opportunities to local zoning and building code officials in subject materials such as damage assessment and mitigation	L	All	5 /B.6	Emergency Management (Damage assessment courses offered annually/ In progress	Locality, VDOT
Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury and or property damage.	L	All	2, 3 /B.6	Emergency Management, GIS as available/ In progress	Locality, VDOT
Identify key critical facilities and provide necessary electrical hook-up, wiring, and switches for emergency generators.	H	All	All	Emergency Management/ In progress	Locality
Evaluate properties within the floodplain for possible elevation or acquisition. In particular, target FEMA's Repetitive Loss Properties throughout the County for possible elevation or acquisition. Work with land trusts to facilitate purchase of land.	H	Flood	1, 4 /C.1-C.4, D.1-D.4	Emergency Management/ In progress	Locality, VDEM
Evaluate at risk roads and implement mitigation measures (e.g. elevation, re-design). Work with VDOT as needed.	L	Flood	2, 5 /B.1-B.5	Emergency Management, Locality intern with VDOT; also devices to measure rainflow for citizens/ In progress	Locality, VDOT
Inspect and clear debris from stormwater drainage system. Encourage VDOT to execute this strategy if needed.	H	All	4 /D.1-Dd.4	Emergency Management and VDOT/ In progress	VDOT
Identify existing flood-prone structures that may benefit from mitigation measures such as elevation or flood-proofing techniques.	L	Flood	1, 4 /C.1-C.4, D.1-D.4	Emergency Management/ In progress	Locality
Develop Reverse 911 system or other public notification system	H	All	All	Management Completed/ In progress	Locality
Establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood-prone areas.	M	Flood	1, 4 /D.1-D.4	Emergency Management/ In progress	Locality
Work with VDOT and other jurisdictions as needed. (Possible partnering with Eagle Scout projects.)	M	All	All	Locality/ In progress	Locality (as desirous of project)
Continue to administer building and zoning regulations to insure proper development within flood prone areas.	M	Flood	3 /B.1-B.5	Planning and Zoning complete for flood/ In progress	Locality
Work with the Virginia Department of Forestry to implement the FIREWISE program in Shenandoah County.	M	Wildfires	5, 6 /D.4	Emergency Management, DOF/ In progress	DOF, VDEM

Table 6.4 – Shenandoah County Action Plan to Implement Mitigation Strategies

Table 6.5 - Town of Edinburg Action Plan to Implement Mitigation Strategies					
Mitigation Action	Priority	Town of Edinburg			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Public notification of winter and severe storm information	**H**	Winter Storm, Severe Thunderstorm	6 / D.1-D.4	Town and County Emergency management / In progress	County, VDEM
Create continuity of operations plan for town utilities and services.	**H**	All	All Goals/All Actions	Town public utilities staff work with County emergency management / In progress	County, Town of Edinburg, and VDEM
Install backup generator for water treatment plant and Well #1.	**H**	All	4 / D.1-D.4	In regional County and Town strategies / Town staff work with County Emergency Management	VDEM
Continue support of the Virginia Department of Forestry's FIREWISE program.	**L**	Fire	5, 6 / A.1-A.6, B.1-B.5 ,D.1-D.4	Town work with County Emergency management and DOF	VDEM, DOF

Table 6.5 – Town of Edinburg Action Plan to Implement Mitigation Strategies

Mitigation Action	Priority	Town of Mt. Jackson Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (i.e., hurricane preparedness week, winter weather awareness day).	H	All	5, 6 / A.1-A.6, D.1-D.4	Town and County Emergency management / In progress work with NWS	County, VDEM
Conduct public education on the principles of "shelter in place".	H	All	6 / D.1-D.4	Town and County Emergency management / In progress work with Schools and other shelters	VDEM
Identify need for back-up generators, communications, and/or vehicles at critical public at critical public facilities. Develop means to address the shortfall identified.	H	All	All	Town and County Emergency Management / In progress	VDEM
Propose a more restrictive floodplain ordinance that will effectively eliminate or minimize development within the floodplain, floodway, and flood base.	H	Flood	1,3 /B.1-B.5, D.1-D.4	Town Staff / In progress	Town of Mt Jackson and or VDEM
Develop a comprehensive debris management plan as an annex to the Emergency Operations Plan.	H	All	5 / C.3, D.1-D.4	Town Staff / In progress	Town of Mt Jackson and or VDEM
Continue support of the Virginia Department of Forestry's FIREWISE program.	M	Fire	5, 6 / A.1-A.6, B.1-B.5, D.1-D.4	Town work with County Emergency management and DOF	VDEM, DOF

Table 6.6 – Town of Mt. Jackson Action Plan to Implement Mitigation Strategies

Table 6.7 – Town of New Market Action Plan to Implement Mitigation Strategies					
Mitigation Action	Priority	Town of New Market			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Design an interactive, animated computer program that describes the sources of inflow and infiltration and the role citizens play in reducing the problem.	H	Flood	1, 5, 6 /B.1-B.5, D.1-D.4	Town working with County Emergency Manager / In progress	VDEM, USGS
Provide up-to-date current weather information through local media on town's website.	H	All	6 / a.5, A.6	Town working with County Emergency Manager / In progress	Town, VDEM
Secure town water sources (wells) through the installation of perimeter fencing and electronic access	H	All	4 / C.2, C.3, C4, D.1-4	Town working with County Emergency Manager / In progress	Town, VDEM, DEQ -VDH Wellhead protection program
Work with the Department of Forestry to implement the FIREWISE program in Page County.	M	Fire	5, 6 / A.1-A.6, B.1-B.5, D.1-D.4	Town work with County Emergency management and DOF	VDEM, DOF

Table 6.7 - Town of New Market Action Plan to Implement Mitigation Strategies

Warren County

Table 6.8 – Warren County Action Plan to Implement Mitigation Strategies

Mitigation Action	Priority	Warren County			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Create training opportunities for departmental staff on how to introduce hazard reduction within the daily activities of government.	H	All	All	Emergency Management R. Farrall / In progress ongoing	Locality
Work with local media outlets to increase awareness of natural hazards and actively promote and participate in seasonal hazard awareness weeks or days.	H	All	All	Emergency Management R. Farrall / In progress ongoing	Locality
Create a pre-disaster family response plan to distribute to members of the community with shelter designation.	H	All	All	Emergency Management R. Farrall / In progress ongoing	Locality
Expand the local emergency management committee to include private sector organizations.	L	All	All	Emergency Management R. Farrall / Completed and continuing to meet	Locality
Work with local home improvement stores, local media outlets and other local agencies to provide workshops to residents on mitigation techniques.	L	All	All	Emergency Management R. Farrall / Not initiated yet	Locality
Integrate the jurisdiction's mitigation plan into the current Capital Improvements Plan, as well as researching other funding opportunities.	H	All	All	T. Logan, M. Wendling, Planning Dept/ in progress	Locality
Review the County's existing floodplain ordinance to ensure that it is meeting local needs.	M	Flood	3/B.2-B.5	T. Logan, Planning Dept/ Completed. To review annually for any updates	Locality
Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FiRMs).	M	Flood	1, 2/C.1-C.4, D.1-D.4	T. Logan, Planning Dept/ Completed. To review annually for any updates	VDEM
Incorporate the hazard mitigation plan goals and strategies into the County's Comprehensive Plan.	M	All	All	T. Logan, Planning Dept/ In progress	Locality
Provide training opportunities to local zoning and building code enforcement staff and educate them on damage assessment, mitigation techniques, and other related topics.	L	All	All	D. Beahm, Building Inspection/ In progress	Building Inspection, David Beahm
Review critical community facilities such as County administrative offices, school buildings, fire stations and police stations to evaluate their resistance to natural and manmade hazards.	H	All	All	Emergency Management, R.Farrall/ In progress	Locality, Emergency Management

Table 6.8 – Warren County Action Plan to Implement Mitigation Strategies *(continued)*

Mitigation Action	Priority	Warren County			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Identify existing flood prone structures that may benefit from mitigation measures such as elevation or flood-proofing techniques.	L	Flood	All	T. Logan, M, Wendling, Planning Department/ not started	Locality
Inspect and clear debris from stormwater drainage systems. Encourage VDOT, Sanitary Districts, and Property Owner Associations to execute this strategy.	L	All	All	Emergency Management, R. Farrall / In progress	Locality, VDOT
Based upon the community's needs and associated risks, staff the Emergency Management Office, Fire and Rescue, Law Enforcement, Parks and Recreation, Building Inspections Department, and Planning and Zoning at adequate levels as determined by County Administration.	H	All	5, 6 /B.1-B.6	Emergency Management and Doug Stanley/ In progress	Locality
Continue support of the Virginia Department of Forestry's FIREWISE program.	M	Wildfires	All	Emergency Management, R. Farrall / In progress	Locality, VDOF

Table 6.8 – Warren County Action Plan to Implement Mitigation Strategies

Table 6.9 – Town of Front Royal Action Plan to Implement Mitigation Strategies

Mitigation Action	Priority	Town of Front Royal			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Utilize opportunities provided by Warren County Emergency Management Department for Town staff on how to introduce hazard reduction within the daily activities of government. This to include a program so key personnel and Department Heads receive basic training in emergency response, such as ICS certifications	H	All	5,6 /A.5, D.1-D.4	Town administration / In progress, initiated and ongoing	Town and County
Coordinate with Warren County Emergency Management Department to work with local media outlets to increase awareness of natural hazards and actively promote and participate in seasonal hazard awareness days or weeks. Includes activities during Health & Wellness Expo annually as schools request	H	All	5, 6/ A.5, A.6	Town administration / In progress, initiated and ongoing	Town and County
Create a pre-disaster family response plan to distribute to members of the community.	M	All	5, 6 / A.3, A.4,A.5,A.6	Town administration and County Emergency Management / In progress, initiated and ongoing	Town and County
Work with local home improvement stores, local media outlets and other local agencies to provide workshops to residents on mitigation techniques.	L	All	5, 6 / A.2, A.3, A.6, D.1-D.4	Town administration and County Emergency Management / Into started	Town and County
Develop additional GIS layers and training opportunities for Town staff to increase their knowledge and ability to use GIS for emergency management	H	All	2/A.3, B.5	Town Planning Department and GIS/ In progress	Town
Coordinate with FEMA and Virginia DCR to continue program of updating and digitizing the community FIRMS	H	Flood	1, 2 / A.1-A.4, B.3, D.1-D.4	Town Planning Department and GIS/ Completed, updated and ongoing as needed In progress	Town
Provide training opportunities to local zoning and building code enforcement staff and educate them on damage assessment, mitigation techniques, and other related topics.	M	All	5, 6 / A.1-A.6, B.4,B.5	Town DES, Energy Services, and Planning Staff / in progress	Town

Table 6.9 – Town of Front Royal Action Plan to Implement Mitigation Strategies *(continued)*					
		Town of Front Royal			
Mitigation Action	Priority	Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Integrate the jurisdiction's mitigation plan into the current Capital Improvements Plan, as well as researching other funding opportunities.	M	All	3 / B.2, B.3	Town Manager / Not started yet	Town
Continue comprehensive inspection and debris removal program for storm water drainage system	H	All	4 /D.1-D.4	Town Environmental Services (J.Hannigan)/ In progress and ongoing	Town
Identify existing flood prone structures that may benefit from mitigation measures such as elevation or flood-proofing techniques. Research grants to fund mitigation implementation	M	Flood	1, 4 / A.3,C.1-C.4	Town Director of Planning / Ongoing, In progress	Town
Based upon the community's needs and associated risks, staff Emergency Management, Fire and Rescue, Law Enforcement, Parks and Recreation, Building Inspections Department, and Planning and Zoning at adequate levels as determined by Town Administration.	M	All	5, 6/ B.1-B.5	Town Manager /In progress	Town
Continue support of the Virginia Department of Forestry's FIREWISE program.	**Medium changed to low priority due to low applicability in Town**	Fire	5,6/A.1-A.6, D.1-D.4	Town staff with County Emergency Management and DOF / in progress limited applicability	DOF and County
Review and develop land development ordinances that facilitate mitigation of hazards and responsiveness to emergencies during disasters	M	All	3/ A.1, B.1-B.5	Town planning Department / In progress, newly added	Town

Table 6.9 - Town of Front Royal Action Plan to Implement Mitigation Strategies

City of Winchester

Table 6.11 – City of Winchester Action Plan to Implement Mitigation Strategies					
		City of Winchester			
Mitigation Action	Priority	Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Procure and install backup generators for lift stations for wastewater treatment plants	H	All	All	Emergency Management Initiated / In progress	VDEM
Create an educational program and administer it throughout the community targeting residents within the City relating to all hazards including pandemic influenza.	H	All	3, 6, 6 /A.1, D.1-D.4	Emergency Management Initiated / In progress	Locality and VDH
Create a local informational brochure and distribute the brochure throughout the community to better inform the community with regard to local emergency preparedness information.	M	All	6 /A.1-A.6	Emergency Management Initiated / In progress	VDEM
Create a Public Education Program within the public and private schools within the community that will provide disaster preparedness information to the student bodies that can be utilized within their individual homes.	M	All	1, 6 /A.1-A.6, D.1-D.4	Emergency Management Initiated / In progress	Locality, VDEM
Create a knowledgeable group of speakers within the community that can be available to present programs regarding Emergency Management Principles and Concepts to groups within the community.	L	All	6/A.1-A.6	Emergency Management Initiated / In progress	VDEM
Conduct public education program throughout the City to residents and businesses relating to the "Shelter Assignments and Management."	L	All	6/A.1-A.6	Emergency Management Initiated / In progress	VDEM
Consider participating in the StormReady Program sponsored by the National Weather Service.	L	Storms, Hurricane, Tornado, Winter Storm	6 / B.5	Emergency Management Initiated / In progress	VDEM, Locality
Develop plans that will provide continuity of operations for Public Safety and other related disciplines.	H	All	3/B.1-B.5	Emergency Management Initiated / In progress	Locality, VDEM
Develop a comprehensive debris management plan as an annex to the Emergency Operations Plan.	H	All	All	Emergency Management Initiated / In progress	VDEM, VDOT, Locality

Table 6.11 – City of Winchester Action Plan to Implement Mitigation Strategies (continued)

Mitigation Action	Priority	City of Winchester			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Provide training opportunities to local zoning and building code officials in subject materials such as damage assessment and mitigation.	L	All	All	Emergency Management Initiated / In progress	Locality
Staff the Departments of Emergency Management, Public Safety and other associated departments at levels that are adequate to support Emergency Program.	L	All	All	Emergency Management Initiated / In progress	Locality, VDEM
Consider providing necessary electrical hook-ups including wiring and switches to allow ready access and connection of emergency generators to key critical oublic facilities.	M	All	All	Emergency Management Initiated / In progress	Locality,VDEM
Continue to develop and enhance the utilization of the Reverse 9-1-1 calling system.	M	All	All	Emergency Management Initiated / In progress	Locality, VDEM
Continue work on the development and administration of Public Education Programs to better educate and prepare the community to deal with natural and man-made disasters .	M	All	All	Emergency Management Initiated / In progress	Locality, VDEM
Investigate all schools prioritizing those used as community shelters for resistance to all natural hazards.	L	All	All	Emergency Management Initiated / In progress	Locality, VDEM
Review and investigate all flood-prone areas within the 100 year floodplain area and incorporate mitigation measures where possible.	L	Flood	2 /B.1-B.5, C.1-C.4, D.1-D.4	Emergency Management Initiated / In progress	Locality, VDEM
Provide NOAA weather radios to all public facilities to permit ready access to weather issued weather statements .	L	All	All	Emergency Management Initiated / In progress	Locality, VDEM
Create training opportunities for staff to increase their knowledge and ability to use GIS for emergency management.	H	All	All	Emergency Management, GIS Initiated / In progress	Locality, VDEM
Provide National Incident Management System and Incident Command System training to all emergency response personnel and other key support personnel.	H	All	All	Emergency Management Initiated / In progress	Locality, VDEM

Table 6.11 – City of Winchester Action Plan to Implement Mitigation Strategies (continued					
Mitigation Action	Priority	City of Winchester			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Inspect and clear debris from storm water drainage systems to prevent property damage from localized flooding created by blocked inlets and transmission systems.	M	All	All	Emergency Management Initiated / In progress	Locality, VDEM, VDOT
Continue to administer building and zoning regulations to insure proper development within flood prone areas.	M	Flood	3/B.1-B.6, D.1-D.4	Planning Initiated / In progress	Locality, VDEM
Evaluate existing storm water systems to determine if it is adequate for existing and future flood hazards.	L	Flood	2/D.1-D.4	Emergency Management Initiated / In progress	Locality, VDEM
Review and modify the Emergency Operations Plan to better address the response to hazardous materials incidents by all emergency response personnel.	L	All	3 /C.1-C.4, D.1-D.4, B.2	Planning Initiated/ In progress	Locality

Table 6.11 – City of Winchester Action Plan to Implement Mitigation Strategies

Northern Shenandoah Valley Regional Commission

Table 6.12 - NSVRC Action Plan to Implement Mitigation Strategies					
Mitigation Action	Priority	Town of Edinburg			
		Hazard(s)	Goals (1-6)/ Actions (A-D)	Responsible Dept/ Status	Funding Source
Assist localities is meeting requirements of the Water Supply Plan Update	**H**	Drought	C4	NSVRC Staff work with VA DEQ	Commission, VDEQ
Maintain hazard mitigation plan/data	**H**	All	A 4-6	NSVRC Staff work with FEMA/VDEM	Commission, Counties and VDEM
Maintain hazard mitigation online portal and web apps	**M**	All	A 4-6	NSVRC Staff	Commission, VDEM
Work with localities on meeting CRS requirements	**L**	Flood	B2	Commission Staff with County Emergency management and DOF	Commission. VDEM

Table 6.12 – NSVRC Action Plan to Implement Mitigation Strategies

Chapter 7: Plan Maintenance

This Chapter 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. The overall goal is for the Plan to remain a living document. This section was updated as part of the 2012 Hazard Mitigation Plan Update.

Per the FEMA guidance (October 2011) FEMA will accept the planning process as defined by the community. The collaborative nature of the steering committee, public, and local officials have been integral in the development and preparation of this Plan update including the format, mitigation strategies, focus on a website (www.NSVemergency.org) as well as other aspects throughout the planning process.

The 2018 revision of the NSV Regional Hazard Mitigation Plan is expected to be adopted by participating jurisdictions in early Spring 2018, prior to the April 8th expiration. The governing body of each locality will be responsible for adopting the Mitigation Plan. Each governing body has the statutory authority to promote actions to prevent the loss of life and property from natural hazards.

The Plan has been endorsed by each local government, via the representative assigned under the jurisdictional Memorandum of Agreement. The next step is for NSVRC staff to submit the Plan to the Virginia Department of Emergency Management (VDEM). The VDEM will then submit the plan to the Federal Emergency Management Agency (FEMA) for review and approval. Following FEMA approval, the local governments will formalize their adoption of the approved Plan through a letter or resolution. NSVRC staff is working with the MOA assigned steering committee representatives, to schedule the work sessions and offer opportunity for adoption at Council and Board sessions throughout February, March and April 2018. Before April, 8 2018, the NSVRC will have a detailed schedule for each date the Plan will be on the agenda for adoption by a locality. This schedule for each locality is presented below based on the most current data available. A representative from the Hazard Mitigation Planning Team will be present for any questions.

Table 7.1 - Northern Shenandoah Valley Region 2018 Hazard Mitigation Plan Adoption Schedule		
Locality	**Work Session**	**Scheduled for Adoption**
Clarke County	**04/2/2018 - 10am**	**09/18/2018 – 1pm**
Berryville	09/11/2018 – 7:30pm	10/09/2018 - 7:30pm
Boyce	09/04/2018 – 7:30pm	10/02/2018 – 7:30pm
Frederick County	09/12/2018 - 7:15pm	09/26/2018 - 7:15pm
Middletown	09/10/2018 – 7pm	10/08/2018 – 7pm
Stephens City	09/04/2018 – 7:30pm	10/02/2018 – 7:30pm
Page County	09/18/2018 – 7pm	10/16/2018 – 7pm
Luray	09/10/2018 – 7pm	10/08/2018 – 7pm
Shenandoah	09/04/2018 – 10am	10/09/2018 – 10am
Stanley	09/12/2018 – 7:30pm	10/10/2018
Shenandoah County	09/25/2018 – 7pm	10/23/2018 – 7pm
Edinburg	09/11/2018 – 7:30pm	10/09/2018 - 7:30pm
Mount Jackson	09/11/2018 – 7:30pm	10/09/2018 - 7:30pm
New Market	09/17/2018 – 7:30pm	10/15/2018 – 7:30pm
Strasburg	09/11/2018 – 7:30pm	10/09/2018 - 7:30pm
Toms Brook	09/13/2018 – 7pm	10/11/2018 – 7pm
Woodstock	09/04/2018 – 7:30pm	10/02/2018 – 7:30pm
Warren County	09/04/2018 – 9am	09/18/2018 – 7pm
Front Royal	09/11/2018 – 7pm	10/09/2018 - 7pm
Winchester city	09/11/2018 – 7pm	10/09/2018 - 7pm

Table 7.1 – Northern Shenandoah Valley Region 2018 Hazard Mitigation Plan Adoption Schedule

All resolutions for adoption of the plan are in Appendix of this 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 NSVRC staff were available to discuss the project at all meetings and hearings.

Each jurisdiction participating in this Plan is responsible for implementing specific mitigation actions as prescribed in the previous chapter. Each action has been assigned to an agency, local government, or where possible, a point of contact that will be a resource for future committee reviews to contact regarding the status of a strategy. Because the locality-specific mitigation actions are directed specifically for each local government, the jurisdictions in the NSV planning region have adopted their locally specific Mitigation Strategy section of the Plan separately. 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. Therefore, individual jurisdictions may update that specific section of the Plan individually, without meeting with the remainder of the Hazard Mitigation Committee.

Some mechanism of annually tracking status (example surveys, etc.) will be implemented to report strategy status to the regional steering committee. The NSVRC or designated committee member(s) will maintain annual database documenting strategy status such as if the strategy has been completed, is on- going, or revised. Details of the annual activities are provided below.

Future 5 year cyclic updates were determined by the steering committee to include the following at a minimum:

- Evaluate the Plan and strategies at the end of each calendar year Survey localities regarding strategy status and provide suggestions for funding, etc.
- The NSVRC staff, as guided by the steering committee, will issue the survey, review responses, and report findings to all participating jurisdictions, maintain on file in a central database at NSVRC, and report survey findings and recommendations to the VDEM annually.
- The annual Hazard Mitigation update report will be submitted to VDEM and FEMA, as well as summarized on the NSVRC website (www.NSVregion.org), making available for public dissemination and comment.
- The NSVRC staff will issue a media release annually that the results of the surveys of local and regional mitigation strategies are complete and available for comment on the website. If the steering committee determines sufficient public interest is initiated in response to the survey results, a public meeting may be held to solicit additional comments.
- The results of any public comments will be included in the annual reporting submitted to VDEM.
- NSVRC staff, as guided by the steering committee, will issue updates and mitigation strategy findings to local businesses, academia, local and regional planning staff, and any state agencies.
- The steering committee will meet twice a calendar each year after the Plan update is approved by FEMA (starting May 2018) and determine if the frequency should be more often based upon needs.
- The results of the findings from the steering committee survey will be included in the NSVRC annual report. The findings will also guide the NSVRC staff work plan annually to ensure support to localities to achieve regional and local mitigation strategies.
- Other annual reviews during the 5-year cycles may include recommendations by state and federal agencies.
- The next formal 5-year Plan update in 2022 will provide a summary of the annual findings.
- The annual survey results will be presented to the Board of Commissioners of the NSVRC representing the participating. Other outreach efforts, as determined appropriate by the steering committee may include presentations and surveys on the NSVemergency website.

- Annual surveys and evaluations for each update by NSVCR staff as guided by the steering committee will also include identification of and a review of any new relevant or pertinent reports, plans, or data that affect natural hazard planning for that community. For example, the annual updates will survey each locality for updated comprehensive or capital improvement plans. As appropriate, the NSVCR planning staff may assist each locality with narrative to update their locality-specific or regional plans to reflect pertinent sections of this Plan, as appropriate.

- The Plan update and evaluations will be issued to the localities and interested stakeholders, by NSVRC staff, as directed by the steering committee, and will include a schedule of the Plan review meetings, current attendees, and an invitation to participate. In addition, the Plan update shall include the title and name of each contact person, how each locality participated to date. The meetings will also be announced to the general public through NSVRC media releases. To afford various groups and interested citizens the opportunity to participate in the update at specific dates and times.

- During the process of this Plan update, the NSVRC staff monthly meetings included summaries of this Plan to identify any potential overlap with other regional or local projects or Plans. Where possible, plans prepared during the time of this update were revised to reflect the 2012 hazard mitigation Plan update. In the future updates, the NSVRC Executive Director will ensure that hazard mitigation plan is discussed at a minimum quarterly annually during NSVRC staff meetings to raise awareness amongst staff where cross over occurs in other program areas between projects and this Plan. In addition, locality-specific or regional plan updates NSVRC staff is aware of will be encouraged to include relevant sections of this Plan update. For example, NSVRC staff discussions may note overlap between natural hazard mitigation planning and community development and housing (property acquisition and improvement efforts), and transportations planning (example road and bridge improvements), and natural resource planning efforts (example stormwater efforts). Regional and local plans, projects, and programs will be updated to reflect pertinent sections of this Plan update.

The annual surveys and updates of the Plan will be coordinated by the NSVRC hazard mitigation planning staff, and reported by Brandon Davis, Executive Director. The Executive Director will identify the responsible staff to meet the requirements of the annual updates, monitoring implementation, and evaluating effectiveness of the Plan. The NSVRC staff will work under the guidance of the hazard mitigation steering committee and report all findings through the steering committee. The steering committee will determine the survey questions and other mechanisms to interview participating jurisdictions regarding the effectiveness of the monitoring the Plan (through annual surveys and reports of findings); evaluating the effectiveness of the Plan and revise protocol as best meets the guidance of the steering committee. In addition the NSVRC hazard mitigation planning staff will coordinate with the steering committee to update and revise the Plan every five years. The executive director of NSVRC shall submit the Plan update to VDEM annually as approved by the steering committee by March starting

March 2014. The participating jurisdictions will be provided with an opportunity to add representatives to the steering committee annually.

The 2022 Plan update that will compile the annual findings, updates, and evaluations will also include the following: each participating locality's review and revisions to the Plan, what documents and plans the locality revised to reflect the 2018 Plan update, progress in local mitigation efforts, and changes in strategy priorities. NSVRC on behalf of the localities or the localities will resubmit if to the state and the state will review and advance it to FEMA for approval in order to continue to be eligible for mitigation project grant funding.

A review of the progress on the 2012 local mitigation strategies was completed as part of this Plan update. In general, most localities have made some progress on their 2012 mitigation strategies, through ordinance reviews, floodplain reviews and management, GIS implementation, and development.

For each identified action, potential funding sources have also been listed that may be used when the jurisdiction begins seeking funding for implementation of the action. These funding sources are not meant to be the only potential funding sources or strategies, but do provide an initial starting point for new projects, as well as projects already in progress. As part of the Hazard Mitigation Steering Committee tracking strategy process, needs for funding can be revisited and updated as needed. It will be the responsibility of each participating jurisdiction to determine additional implementation procedures beyond the Mitigation Action SubPlan, listed in this Plan. Individual localities will be responsible for integrating the Plan into other planning documents, processes or mechanisms such as comprehensive or capital improvement plans, where appropriate. Local officials, planners, and emergency management staff are encouraged to continue to advocate for review and inclusion of identified mitigation strategies into relevant local plans and ordinances, as necessary.

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. This will also include updates to the list of critical facilities. An additional update that will be addressed is the compliance with any new state and federal regulations that could affect the mitigation strategies.

In addition to annual updates conducted by review through the Regional Hazard Mitigation Steering Committee, or designee, this Plan is mandated for a five-year update in 2023. Any increases in population, development, natural setting, urban areas, and new technology for assessing hazards or reducing risks from hazards will be included. In addition, the five-year update will also include any FEMA mapping revisions, or maps where there previously was a lack of coverage. The 2018 update of the NSV Regional Hazard Mitigation Plan will be required to be adopted by all participating jurisdictions. Any local amendments adopted individually will be incorporated into the 2018 updated Plan.

NSVRC and or the Regional Hazard Steering Committee will be responsible for the continued coordination of the annual monitoring of this plan. The Emergency Management Coordinator from each County and the City will provide annual updates to the Committee and or NSVRC staff for an annual report to VDEM. The yearly reports will be compiled at the end of each calendar year, or as identified by the Hazard Mitigation Committee. If any of the Counties or Towns that participated in this planning effort wishes to not participate in future updates of the Plan, they must notify NSVRC Executive Director in writing.

To facilitate the localities with grant writing, the annual reviews of this Plan will include a listing of any and all new disaster declarations. Annual losses will be reported by the County and City Emergency Management Coordinators. NSVRC staff will maintain the documentation for the annual reviews of the Plan and house them in a central location, available to all participating localities. These annual updates will serve as the basis for the future 2018 update to the NSV Regional Hazard Mitigation Plan. The NSVRC staff will review the results of the annual survey and evaluations and ensure localities are informed of opportunities to revise plans to incorporate regional and local hazard mitigation updates and reference this Plan and future iterations.

The results of the five-year review will be summarized in a report prepared by NSVRC staff and reported to the Board of Commissioners for the NSVRC, or to a designated committee. This annual reporting will include summary of any strategy changes in the Plan, an evaluation of the effectiveness of the Plan, and recommendations by the localities, as appropriate. To be included in future updates of the Plan, as information becomes available, is an assessment of climate change and the impacts to the NSV Region.

Appendices

Appendix A – Memorandum of Agreement/Sample Adoption Agreement

Memorandum of Agreement:

NSVRC
NORTHERN SHENANDOAH VALLEY REGIONAL COMMISSION

Memorandum of Agreement to Participate in 2017 Multi-jurisdictional Hazard Mitigation Plan Update

A Memorandum of Agreement (MOA) is hereby executed between the participating jurisdictions in the Hazard Mitigation Plan. "Participating jurisdictions" in this MOA are as follows:

- Clarke County, Virginia
- Frederick County, Virginia
- Page County, Virginia
- Shenandoah County, Virginia
- Warren County, Virginia
- City of Winchester, Virginia

The purpose of this MOA is to establish commitment from and a cooperative working relationship between all Participating Jurisdictions in the development and implementation of the Hazard Mitigation Plan. In addition, the intent of this MOA is to ensure that the multi-jurisdictional hazard mitigation plan is developed in accordance with Title 44 of the Federal Code of Regulations (CFR) Part 201.6; that the planning process is conducted in an open manner involving community stakeholders; that it is consistent with each participating jurisdiction's policies, programs and authorities; and it is an accurate reflection of the community's values.

This MOA sets out the responsibilities of all parties. The MOA identifies the work to be performed by each participating jurisdiction. Planning tasks, schedules, and finished products are identified in the Work Program and Schedule. The plan created as a result of this MOA will be presented to the governing body (Planning Commission, City Council and or Board of Commissioners) of each participating jurisdiction for adoption.

Mitigation plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. The Participating Jurisdictions in a mitigation planning process would benefit by:

- identifying cost effective actions for risk reduction;
- directing resources on the greatest risks and vulnerabilities;
- building partnerships by involving people, organizations, and businesses;
- increasing education and awareness of hazards and risk;
- aligning risk reduction with other community objectives; and
- providing eligibility to receive federal hazard mitigation grant funding.

The Northern Shenandoah Valley Regional Commission has received a grant from the Federal Emergency Management Agency to prepare a multi-jurisdictional hazard mitigation plan in accordance with 44 FEMA requirements at 44.C.F.R. 201.6.

The Northern Shenandoah Valley Regional Commission will act as the project lead, and will assign a Chairperson of the Planning Team for the Hazard Mitigation Plan. The Participating Jurisdictions authorize the Lead Community to manage and facilitate the planning process in accordance with the Work Program and Schedule.

Clarke County MOA:

The Participating Jurisdictions understand that representatives must engage in the following planning process, as more fully described in the *Local Mitigation Planning Handbook* (FEMA, 2012), including, but not limited to:

- Develop the Work Program and Schedule with the Planning Team
- Organize and attend regular meetings of the Planning Team.
- Assist the Planning Team with developing and conducting an outreach strategy to involve other planning team members, stakeholders, and the public, as appropriate to represent their Jurisdiction.
- Identify community resources available to support the planning effort, including meeting spaces, facilitators, and media outlets.
- Provide data and feedback to develop the risk assessment and mitigation strategy, including a specific mitigation action plan for their Jurisdiction.
- Submit the draft plan to their Jurisdiction for review.
- Work with the Planning Team to incorporate all their Jurisdiction's comments into the draft plan.
- Submit the draft plan to their respective governing body for consideration and adoption.
- After adoption, coordinate a process to monitor, evaluate, and work toward plan implementation.

The following points of contacts and alternatives are authorized on behalf of the [~~insert jurisdiction~~ Clarke County] to participate as members of the Planning Team for the Hazard Mitigation:

- Name: Brian Lichty
- Title: Director Fire, Rescue and Emergency Management
- Office/Agency: Clarke County
- Name of Participating Jurisdiction: Clarke County
- Address: 101 Chalmers Court, Suite 101
  Berryville VA 22611
- Phone number: (o) 540-955-5113, (c) 540-277-7993
- Email address: blichty@clarkecounty.gov

This MOA will be in effect from the date of signature by all parties, will remain in effect through the duration of the planning process, and will terminate after adoption of the final FEMA-approved mitigation plan by all participating jurisdictions, or 5 years after FEMA approval, whichever is earlier. It may be terminated prior to that time for any Participating Jurisdiction by giving 60 days written notice. This MOA is to be implemented through the attached Work Program and Schedule, and any addendums that describe specific activities, programs, and projects, and if necessary, funding by separate instrument.

Signature: Brian Lichty Date: 8/6/17

Print Name: Brian Lichty Title: Director

Frederick County MOA:

The Participating Jurisdictions understand that representatives must engage in the following planning process, as more fully described in the *Local Mitigation Planning Handbook* (FEMA, 2012), including, but not limited to:

- Develop the Work Program and Schedule with the Planning Team
- Organize and attend regular meetings of the Planning Team.
- Assist the Planning Team with developing and conducting an outreach strategy to involve other planning team members, stakeholders, and the public, as appropriate to represent their Jurisdiction.
- Identify community resources available to support the planning effort, including meeting spaces, facilitators, and media outlets.
- Provide data and feedback to develop the risk assessment and mitigation strategy, including a specific mitigation action plan for their Jurisdiction.
- Submit the draft plan to their Jurisdiction for review.
- Work with the Planning Team to incorporate all their Jurisdiction's comments into the draft plan.
- Submit the draft plan to their respective governing body for consideration and adoption.
- After adoption, coordinate a process to monitor, evaluate, and work toward plan implementation.

The following points of contacts and alternatives are authorized on behalf of the [insert jurisdiction] to participate as members of the Planning Team for the Hazard Mitigation:

- Name: CHESTER LAUCK
- Title: DEPUTY EMERGENCY MGMT. COORDINATOR
- Office/Agency: FREDERICK CO. FIRE & RESCUE
- Name of Participating Jurisdiction: FREDERICK COUNTY
- Address: 107 N. KENT ST.
  WINCHESTER, VA 22601
- Phone number: (540) 665-5618
- Email address: clauck@co.frederick.va.us

This MOA will be in effect from the date of signature by all parties, will remain in effect through the duration of the planning process, and will terminate after adoption of the final FEMA-approved mitigation plan by all participating jurisdictions, or 5 years after FEMA approval, whichever is earlier. It may be terminated prior to that time for any Participating Jurisdiction by giving 60 days written notice. This MOA is to be implemented through the attached Work Program and Schedule, and any addendums that describe specific activities, programs, and projects, and if necessary, funding by separate instrument.

Signature: CJ Lauck   Date: 1/10/18

Print Name: Chester T. Lauck   Title: Deputy Emergency Management Coor.

Page County MOA:

The Participating Jurisdictions understand that representatives must engage in the following planning process, as more fully described in the *Local Mitigation Planning Handbook* (FEMA, 2012), including, but not limited to:

- Develop the Work Program and Schedule with the Planning Team
- Organize and attend regular meetings of the Planning Team.
- Assist the Planning Team with developing and conducting an outreach strategy to involve other planning team members, stakeholders, and the public, as appropriate to represent their Jurisdiction.
- Identify community resources available to support the planning effort, including meeting spaces, facilitators, and media outlets.
- Provide data and feedback to develop the risk assessment and mitigation strategy, including a specific mitigation action plan for their Jurisdiction.
- Submit the draft plan to their Jurisdiction for review.
- Work with the Planning Team to incorporate all their Jurisdiction's comments into the draft plan.
- Submit the draft plan to their respective governing body for consideration and adoption.
- After adoption, coordinate a process to monitor, evaluate, and work toward plan implementation.

The following points of contacts and alternatives are authorized on behalf of the [insert jurisdiction] to participate as members of the Planning Team for the Hazard Mitigation:

- Name: Woody Brown
- Title : Coordinator of Emergency Services
- Office/Agency : Page Co. Fire-EMS
- Name of Participating Jurisdiction: Page County
- Address: 105 S. Court St.
Suite F
Luray, VA 22835
- Phone number: (540) 743-4142
- Email address: wbrown@pagecounty.virginia.gov

This MOA will be in effect from the date of signature by all parties, will remain in effect through the duration of the planning process, and will terminate after adoption of the final FEMA-approved mitigation plan by all participating jurisdictions, or 5 years after FEMA approval, whichever is earlier. It may be terminated prior to that time for any Participating Jurisdiction by giving 60 days written notice. This MOA is to be implemented through the attached Work Program and Schedule, and any addendums that describe specific activities, programs, and projects, and if necessary, funding by separate instrument.

Signature: [signature] Date: 1/18/18

Print Name: Woody Brown Title: Coordinator

Shenandoah County MOA:

The Participating Jurisdictions understand that representatives must engage in the following planning process, as more fully described in the *Local Mitigation Planning Handbook* (FEMA, 2012), including, but not limited to:

- Develop the Work Program and Schedule with the Planning Team
- Organize and attend regular meetings of the Planning Team.
- Assist the Planning Team with developing and conducting an outreach strategy to involve other planning team members, stakeholders, and the public, as appropriate to represent their Jurisdiction.
- Identify community resources available to support the planning effort, including meeting spaces, facilitators, and media outlets.
- Provide data and feedback to develop the risk assessment and mitigation strategy, including a specific mitigation action plan for their Jurisdiction.
- Submit the draft plan to their Jurisdiction for review.
- Work with the Planning Team to incorporate all their Jurisdiction's comments into the draft plan.
- Submit the draft plan to their respective governing body for consideration and adoption.
- After adoption, coordinate a process to monitor, evaluate, and work toward plan implementation.

The following points of contacts and alternatives are authorized on behalf of the [insert jurisdiction] to participate as members of the Planning Team for the Hazard Mitigation:

- Name: Jill Jefferson
- Title: County Planner
- Office/Agency: Shenandoah County Community Development
- Name of Participating Jurisdiction: Shenandoah County
- Address: 600 N. Main St., Suite 107
  Woodstock, VA 22664
- Phone number: 540-459-6204
- Email address: jjefferson@shenandoahcountyva.us

This MOA will be in effect from the date of signature by all parties, will remain in effect through the duration of the planning process, and will terminate after adoption of the final FEMA-approved mitigation plan by all participating jurisdictions, or 5 years after FEMA approval, whichever is earlier. It may be terminated prior to that time for any Participating Jurisdiction by giving 60 days written notice. This MOA is to be implemented through the attached Work Program and Schedule, and any addendums that describe specific activities, programs, and projects, and if necessary, funding by separate instrument.

Signature: Mary T. P[illegible] Date: August 8, 2017

Print Name: Mary T. Price Title: County Administrator

Warren County MOA:

The Participating Jurisdictions understand that representatives must engage in the following planning process, as more fully described in the *Local Mitigation Planning Handbook* (FEMA, 2012), including, but not limited to:

- Develop the Work Program and Schedule with the Planning Team
- Organize and attend regular meetings of the Planning Team.
- Assist the Planning Team with developing and conducting an outreach strategy to involve other planning team members, stakeholders, and the public, as appropriate to represent their Jurisdiction.
- Identify community resources available to support the planning effort, including meeting spaces, facilitators, and media outlets.
- Provide data and feedback to develop the risk assessment and mitigation strategy, including a specific mitigation action plan for their Jurisdiction.
- Submit the draft plan to their Jurisdiction for review.
- Work with the Planning Team to incorporate all their Jurisdiction's comments into the draft plan.
- Submit the draft plan to their respective governing body for consideration and adoption.
- After adoption, coordinate a process to monitor, evaluate, and work toward plan implementation.

The following points of contacts and alternatives are authorized on behalf of the [insert jurisdiction] to participate as members of the Planning Team for the Hazard Mitigation:

- Name: Rick Farrall
- Title : Cost Recovery / Deputy ~~Emergency~~ Emergency Manager
- Office/Agency : Warren Co. Fire & Rescue Services
- Name of Participating Jurisdiction: Warren County
- Address: 200 Skyline Vista Dr
Suite 200
Front Royal, VA 22630
- Phone number: (540) 636-3830
- Email address: rfarrall@warrencountyfire.com

This MOA will be in effect from the date of signature by all parties, will remain in effect through the duration of the planning process, and will terminate after adoption of the final FEMA-approved mitigation plan by all participating jurisdictions, or 5 years after FEMA approval, whichever is earlier. It may be terminated prior to that time for any Participating Jurisdiction by giving 60 days written notice. This MOA is to be implemented through the attached Work Program and Schedule, and any addendums that describe specific activities, programs, and projects, and if necessary, funding by separate instrument.

Signature: ____________ Date: 1-10-2018

Print Name: R. Farrall Title: Deputy Emergency Manager

City of Winchester MOA:

The Participating Jurisdictions understand that representatives must engage in the following planning process, as more fully described in the *Local Mitigation Planning Handbook* (FEMA, 2012), including, but not limited to:

- Develop the Work Program and Schedule with the Planning Team
- Organize and attend regular meetings of the Planning Team.
- Assist the Planning Team with developing and conducting an outreach strategy to involve other planning team members, stakeholders, and the public, as appropriate to represent their Jurisdiction.
- Identify community resources available to support the planning effort, including meeting spaces, facilitators, and media outlets.
- Provide data and feedback to develop the risk assessment and mitigation strategy, including a specific mitigation action plan for their Jurisdiction.
- Submit the draft plan to their Jurisdiction for review.
- Work with the Planning Team to incorporate all their Jurisdiction's comments into the draft plan.
- Submit the draft plan to their respective governing body for consideration and adoption.
- After adoption, coordinate a process to monitor, evaluate, and work toward plan implementation.

The following points of contacts and alternatives are authorized on behalf of the [insert jurisdiction] to participate as members of the Planning Team for the Hazard Mitigation:

- Name: LYNN MILLER
- Title: EMERGENCY MGMT. COORDINATOR
- Office/Agency: EMERGENCY MANAGEMENT
- Name of Participating Jurisdiction: CITY OF WINCHESTER
- Address: TIMBROOK PUBLIC SAFETY CENTER
  231 E. PICCADILLY ST.
  WINCHESTER, VA 22601
- Phone number: (540) 545-4721
- Email address: lynn.miller@winchesterva.gov

This MOA will be in effect from the date of signature by all parties, will remain in effect through the duration of the planning process, and will terminate after adoption of the final FEMA-approved mitigation plan by all participating jurisdictions, or 5 years after FEMA approval, whichever is earlier. It may be terminated prior to that time for any Participating Jurisdiction by giving 60 days written notice. This MOA is to be implemented through the attached Work Program and Schedule, and any addendums that describe specific activities, programs, and projects, and if necessary, funding by separate instrument.

Signature: [signature] Date: 1-10-18

Print Name: LYNN A. Miller Title: E.M. Coordinator

Sample Adoption Resolution:

MODEL RESOLUTION ADOPTING A NATURAL HAZARDS MITIGATION PLAN FOR NORTHERN SHENANDOAH VALLEY COMMUNITIES:

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to receive certain federal assistance, and

WHEREAS, a Hazard Mitigation Plan Update Steering Committee comprised of representatives from Clarke County, Frederick County, Page County, Shenandoah County, Warren County, the City of Winchester, was convened in order to study the Northern Shenandoah Valley's risks from and vulnerabilities to natural hazards, and to make recommendations on mitigating the effects of such hazards on the Northern Shenandoah Valley; and

WHEREAS, a request for proposals was issued to hire an experienced consulting firm to work with the steering committee to develop a comprehensive natural hazard mitigation plan for the Northern Shenandoah Valley; and

WHEREAS, the efforts of the steering committee members and the Northern Shenandoah Valley Regional Commission, in consultation with members of the public, private and non-profit sectors, have resulted in the development of a Hazard Mitigation Plan for the Northern Shenandoah Valley including (jurisdiction name).

NOW THEREFORE, BE IT RESOLVED by the (governing board's name) that the Hazard Mitigation Plan dated (   ) is hereby approved and adopted for the (jurisdiction name). A copy of the plan is attached to this resolution.

ADOPTED by the (County) this ___ day of ___________________, 2018.

APPROVED:

____

(Chairman, Board of Supervisors)

ATTEST:

____

(Clerk of the County)

Appendix B – List of Tables and Figures

Chapter 2:

Chapter 3:

Chapter 3 (continued):

Chapter 3 (continued):

Chapter 4:

Chapter 4 (continued):

Chapter 5:

Chapter 6:

Chapter 7:

Appendix C – Hazard Histories

Appendix C – Hazard Histories

Table C-1. Northern Shenandoah Federal Disasters

Date of Declaration	Disaster Number	Type of Disaster	Description
6/23/1972	FEMA - 339- DR	Tropical Storm Agnes	This event produced devastating flooding throughout the Mid-Atlantic States. Some areas of eastern Virginia received over 15 inches of rainfall as the storm moved through. The Potomac and James Rivers experienced major flooding, which created 5 to 8 feet flood waters in many locations along the rivers. Richmond was impacted the most by these high water levels. Water supply and sewage treatment plants were inundated, as were electric and gas plants. Only one of the five bridges across the James River was open, while the downtown Richmond area was closed for several days and businesses and industries in the area suffered immense damage. Sixteen people lost their lives in the state and damage was estimated at $222 million. These startling numbers resulted in 63 counties and 23 cities qualifying for disaster relief.
10/10/1972	FEMA - 359- DR	Severe Storms & Flooding	Federal summary not available.
11/9/1985	FEMA - 755- DR	Severe Storms & Flooding Election Day Flood	Heavy rainfall from October 31 through November 6, 1985, caused record-breaking floods over a large region, including western and northern Virginia. Most of the rain fell on November 4 and 5 causing flash flooding. Heavy rainfall was indirectly related to Hurricane Juan. The Roanoke River rose seven feet in one hour and 18 feet in six hours, cresting at 23 feet on November 5 .There was 22 deaths in Virginia as a result of the flooding. FEMA declared 50 jurisdictions disaster areas, 1.7 million people were affected by the flooding. Flooding damages were estimated at $800 million.
5/19/1992	FEMA - 944- DR	Severe Storms & Flooding	Federal summary not available.
7/1/1995	FEMA - 1059- DR	Severe Storms & Flooding	Federal summary not available.
1/13/1996	FEMA - 1086- DR	Blizzard of 1996 (Severe Storm)	Also known as the "Great Furlough Storm" due to Congressional impasse over the federal budget, the blizzard paralyzed the Interstate 95 corridor, and reached westward into the Appalachians where snow depths of over 48 inches were recorded. Several local governments and schools were closed for more than a week. The blizzard was followed with another storm, which blanketed the entire state with at least one foot of snow. To compound things, heavy snowfall piled on top of this storm's accumulations in the next week, which kept snow pack on the ground for an extended period of time. This snow was eventually thawed by higher temperatures, and heavy rain that fell after this thaw resulted in severe flooding. Total damage between the blizzard and subsequent flooding was over $30 million.

Table C-1. Northern Shenandoah Federal Disasters			
Date of Declaration	**Disaster Number**	**Type of Disaster**	**Description**
1/27/1996	FEMA - 1098- DR	Flooding (Snow Melt)	Just one week after 2 to 4 feet of snow fell over western Virginia, temperatures warmed into the 60°s ahead of a front which brought thunderstorms and heavy rain. The sudden warm-up caused a rapid snowmelt. The melted snow was the equivalent of 2 to 4 inches of rain. Some areas saw another 2 to 5 inches of rainfall on top of the melted snow. The saturated ground meant that all the rain and snow became run off into the streams and rivers, which could not handle it. Major flooding resulted. This type of event had not happened since March 1936.
9/6/1996	FEMA - 1135- DR	Hurricane Fran	This hurricane is notable not only for the $350 million in damages it caused, but also because of its widespread effects, including a record number of people without power and the closure of 78 primary and 853 secondary roads. Rainfall amounts between 8 and 20 inches fell over the mountains and Shenandoah Valley, leading to record-level flooding in many locations within this region. 100 people had to be rescued from the flood waters, and hundreds of homes and buildings were damaged by the flood waters and high winds.
2/28/2000	FEMA - 1318- DR	2000 Winter Storms	A storm that was expected to move away from the coast instead rapidly intensified off Georgia and headed almost due north. The Nor'easter spread heavy snow into Virginia during the night of the 24th and through the 25th. Storm warnings were posted for the late news on the 24th, but those who went to bed early without catching the news were startled to see the heavy white stuff falling in the morning. Several inches of snow were on the ground at daybreak, with winds gusting at 25 to 45 mph creating blizzard conditions in some areas. The region was at a stand-still. Airports and transit systems were shut down, schools were closed, and Federal, state and county government offices were closed or quickly closed once the full impact of the storm was realized. Some federal employees in Northern Virginia who begin their commutes well before the government shutdown at 7 am were left battling the storm in their attempts to return home. The heaviest band of snow fell from south central Virginia through Petersburg and the Northern Neck with a foot to a foot and a half of snow. Drifts of four to five feet were common. Snow mixed with sleet and freezing rain in some of the eastern counties. For those who did venture out on the 25th, numerous traffic accidents occurred. Virginia Beach alone recorded 84 during the storm. Strong winds pushed the tide in causing flooding of some roads. The most significant flooding was reported in the Grandview area of Hampton. Some beach erosion occurred along the shore and the U.S. Coast Guard rescued four crewmembers of a vessel caught in the rough seas off Cape Charles. Cold weather followed with the fresh snow pack and temperatures fell into the single digits in the western valleys and piedmont. One woman died of hypothermia.

Table C-1. Northern Shenandoah Federal Disasters

Date of Declaration	Disaster Number	Type of Disaster	Description
5/5/2002	FEMA-1411-DR	Severe Storms & Tornado	Federal summary not available.
9/18/2003	FEMA-1491-DR	Hurricane Isabel	Hurricane Isabel entered Virginia September 18 after making landfall along the North Carolina Outer Banks. The Commonwealth sustained tropical storm winds for 29 hours with some maximum winds approaching 100 mph. The hurricane produced a storm surge of 5 to 8 feet along the coast and in the Chesapeake Bay, with rainfall totals between 2 to 11 inches along its track. Twenty-one inches of rainfall was measured near Waynesboro Virginia. Damages due to wind, rain, and storm surge resulted in flooding, electrical outages, debris, transportation interruption, and damaged homes and businesses. At the height of the incident, approximately 6,000 residents were housed in 134 shelters and curfews were imposed in many jurisdictions. Further damages occurred when a series of thunderstorms and tornados came through many of the designated areas in the southeast portion of Virginia on September 23. There were a total of 36 confirmed deaths. FEMA received more than 93,000 registrations for assistance. Residential destruction included 1,186 homes reported destroyed and 9,110 with major damage, $107,908 minor damage, with losses estimated over $590 million. Of the 1,470 businesses involved, 77 were reported destroyed, 333 suffered major damage and 1,060 businesses suffered minor or casual damage, with losses exceeding $84 million. FEMA Public Assistance grants exceed $250 million and continue to increase. More than two-thirds of the households and businesses within the Commonwealth were without power. Remote locations did not have power restored for three weeks.
3/27/2003	FEMA-1458-DR	Severe Winter Storm, Snowfall, Heavy Rain, Flooding, and Mudslides	The most significant storm of the 2003-04 winter season impacting almost the entire state occurred from late February 14th through the morning hours on February 18th. Three rounds of precipitation resulted in 20 to 36 inches of snow across far northern Virginia, decreasing to between 7 and 12 inches of snow and sleet in the central part of the state, to mainly several inches of sleet and/or 1/4 to 1/2 inch of ice accretion in the south. A 24-hour snowfall of 16.7 inches at Ronald Reagan National Airport was the 5th highest on record. Charlottesville recorded almost 9 inches of sleet from the storm.
September 22, 2006	DR-1661	Severe Storms and Flooding, Including Severe Storms and Flooding Associated with Tropical Depression	Virginia Severe Storms and Flooding Associated with Tropical Depression Ida and a Nor'easter event November 11, 2009 to November 16, 2009

Table C-1. Northern Shenandoah Federal Disasters			
Date of Declaration	**Disaster Number**	**Type of Disaster**	**Description**
December 9, 2009	DR-1862	Severe Storms and Flooding, Including Severe Storms and Flooding Associated with Tropical Depression	Virginia Severe Storms and Flooding Associated with Tropical Depression Ida and a Nor'easter event November 11, 2009 to November 16, 2009; Major Disaster Declaration declared on December 9, 2009
February 16, 2010	DR-1874	Severe Winter Storms and Snowstorm	Virginia Severe Winter Storm and Snowstorm event December 18, 2009 to December 20, 2009; Major Disaster Declaration declared on February 16, 2010
April 27, 2010	DR-1905	Severe Winter Storms and Snowstorm	Virginia Severe Winter Storms and Snowstorms event February 5, 2010 to February 11, 2010; Major Disaster Declaration declared on April 27, 2010
February 20, 2011	FM-2860	Fire Event	Virginia Smith Fire event February 19, 2011; Fire Management Assistance Declaration declared on February 20, 2011
February 20, 2011	FM-2861	Fire Event	Virginia Smith Fire event February 19, 2011; Fire Management Assistance Declaration declared on February 20, 2011
August 26, 2011	EM-3329	Hurricane	Virginia Hurricane Irene event August 26, 2011 to September 4, 2011; Emergency Declaration declared on August 26, 2011
November 4, 2011	DR-4042	Earthquake	Virginia Earthquake event August 23, 2011 to October 25, 2011; Major Disaster Declaration declared on November 4, 2011
November 17, 2011	DR-4045	Tropical Storm	Tropical Storm Lee event September 8, 2011 to September 9, 2011; Major Disaster Declaration declared on November 17, 2011
July 27, 2012	DR-4072	Severe Storms and Straight-line Winds	Virginia Severe Storms and Straight-line Winds event June 29, 2012 to July 1, 2012; Major Disaster Declaration declared on July 27, 2012
October 29, 2012	EM-3359	Hurricane	Virginia Hurricane event "Sandy" – incident period October 26, 2012 – November 01, 2012; Emergency Declaration declared on October 29, 2012
November 26, 2012	DR-4092	Hurricane	Virginia Hurricane event "Sandy" – incident period October 26, 2012 – November 08, 2012; Emergency Declaration declared on November 26, 2012
March 07, 2016	DR-4262	Winter Storm And Snowstorm	Virginia Severe Winter Storm And Snowstorm - Incident period: January 22, 2016 to January 23, 2016; Major Disaster Declaration declared on March 07, 2016
November 02, 2016	DR-4291	Hurricane	Virginia Hurricane event "Matthew" - Incident period: October 07, 2016 to October 15,

Table C-1. Northern Shenandoah Federal Disasters			
Date of Declaration	Disaster Number	Type of Disaster	Description
			2016; Major Disaster Declaration declared on November 02, 2016

Table C-2. Winter Storm Hazard History	
Date	Damages
December 25, 1969	*(Source: The Clarke Courier and Page News and Courier)* Clarke and Page Counties received 15 inches of snow with drifts 6-7 feet high. Winds were estimated at 60-70 mph. This was the worst snow storm since 1966. For this event, most secondary roads were closed and primary roads were partially open. Clarke County: 85 people were stranded in Berryville. Page County: 5 were hurt in a crash involving 3 vehicles near Grove Hill.
December 13, 1995	An upper-level jet streak interacted with a cold dome of arctic air to produce a mixed bag of precipitation over all of northern Virginia during the late evening of the 13th and early morning of the 14th. The precipitation began as light snow during the late afternoon of the 13th, dropping one to three inches over the central Shenandoah Valley. Warmer air aloft arrived by mid-evening, at the same time the precipitation band shifted north into extreme northern Virginia and the western suburbs of Washington. The snow changed to light freezing rain and drizzle. Although precipitation amounts were light (generally less than one-tenth of an inch), havoc was wreaked on area highways since air temperatures, and thus road temperatures, had been below freezing 72 hours prior to the onset of the precipitation. A thin layer of "black ice" caused nearly 1,000 accidents on Virginia highways alone, and portions of Interstates 81 (Shenandoah Valley), 66 (northern piedmont), and 95/395 (southern Washington, DC suburbs) were closed during the evening. In Shenandoah

Table C-2. Winter Storm Hazard History	
Date	**Damages**
	County, a tractor-semi trailer exploded after striking another rig at an entrance ramp; damage to both vehicles (and destroyed cargo) totaled nearly $100 thousand. Two people perished in accidents, and a third died after a heart attack which followed an accident. Dozens of serious injuries occurred on northern and central Virginia highways well into the morning of the 14th. The worst accident occurred on Interstate 95 near Franconia, when an automobile with three teenagers became airborne, flipped over a guard rail, and lodged in a tree. An 18-year-old male was killed, and the two other passengers were critically injured. In Shenandoah County, a 48-year-old man was crushed to death when his car swerved ahead of an empty tour bus and struck a guard rail. The bus then struck the car, jamming it against the rail. An 80-year-old man died, also in Shenandoah County near Toms Brook, when he suffered a heart attack shortly after he stepped out of his damaged vehicle. At least 40 people sustained bone, joint, and back injuries after falling on the ice.
December 19, 1995	The combination of low pressure over the southern Ohio Valley, a cold high pressure ridge extending over the region from south-central Canada, and warm air aloft created significant icing over extreme northwest Virginia during the early afternoon of the 19th. Ice accretions of around one-quarter inch caused a few tree limbs and power lines to snap, producing isolated power outages over the northern half of Frederick, Clarke, and Loudoun Counties, as well as at higher elevations. The precipitation quickly turned to sleet by mid-afternoon, reducing the impact of the ice but snarling traffic nonetheless. Dulles International Airport (VAZ042) was temporarily closed in order to de-ice runways and aircraft. In Winchester (VAZ028), unofficial precipitation measurements indicated six-tenths liquid equivalent of freezing rain, followed by one to two inches of sleet and snow. Earlier that week (the 18th), slight accumulations of freezing rain caused numerous accidents over the northern Shenandoah Valley, with one wreck near New Market (VAZ027) causing two serious injuries.

Table C-2. Winter Storm Hazard History	
Date	**Damages**
January 13, 1996	*(Source: The Page News and Courier, The Clarke Courier, The Shenandoah Valley-Herald and The Warren Sentinel)* On Saturday, January 6th through Monday morning, January 8th, a severe snow storm system entered Virginia producing 27 inches of snow in Berryville, 25 inches in Boyce, 30 inches in Front Royal, 24 inches in Clarke County, 36 inches in Warren County, 32 inches in Alma, 33 inches in Stanley, 38 inches in Luray, 38 inches at Shenandoah National Park, 47 inches at Big Meadows, 30 plus inches in Shenandoah County, with drifts up to 10 feet. Page County: 8 families were evacuated from the Skyline Lakes Subdivision near Stanley. Page County schools were out 7 days and many businesses were closed. Several trailer roofs collapsed or were sagging. Snow impacted home health care system. Clarke County: This snow event delayed mail delivery, closed or reduced business hours, and collapsed roofs on two businesses. Dairy farms were forced to dump milk due to delivery trucks unable to get to farms for pickups. Snow removal costs: $18,000 estimated. Warren County: This event surpassed 1993's storm of the century. In March of that year, 34 inches of snow fell in 24 hours with winds up to 50 mph. For this event several subdivisions were snowed in. Shenandoah Farms residents were stranded without food and supplies. A ceiling collapsed at a tool production facility. Mail service was temporary shut down and later delayed. There were minimal power, water, sewer and phone disruptions. Campers had to be rescued from Shenandoah National Park. County snow removal costs: $90,000 estimated. Shenandoah County: This event caused road problems, power and supply shortages (mostly in Woodstock), roof collapses, abandoned cars, and closed schools. Getting feed to livestock proved to be difficult.
January 27, 1996	*(Source: The Page News and Courier, The Clarke Courier, The Shenandoah Valley-Herald and The Warren Sentinel)* On January 27th, along with above freezing temperatures, 1.5 to 2 inches of rain fell in the region causing one of the worst flooding events in years. The Shenandoah River crested at 21 feet in Page County, 24.9 feet in Clarke County, 25 feet in Warren County, 27.83 feet in Shenandoah County Page County: This event produced the worst flooding in over 10 years. Melting snow and rainfall turned creeks into rivers. At one point Page County was under a high wind warning, flash flood warning, and winter weather advisory. 38 secondary roads were closed, closing all county schools. Flooded streets in Luray included Ninth Ave, Virginia Avenue, Third Street, Linden Avenue and First Street. Portions of US 340 were closed and the VA 677 bridge in Dry Run area of Luray was heavily damaged. Water from Hawksbill Creek overflowed into Mechanic Street. Raw sewage overflowed into several homes on Reservoir Avenue in Luray. Footbridges at Lake Arrowhead were washed out. Residents were evacuated in Weaver Hollow near the Page Rockingham County border. Sections of the Skyline Lakes dam were eroded Clarke County: Damage here was widespread. Many people outside of flood prone areas had water in their basements. One home was condemned and 58 homes were damaged, mostly with flooded basements. Recreation facilities in Watermelon Park were destroyed. Berryville's water filtration and sewage treatment plants were damaged. 21 roads in the county were submerged. Historic Burwell-Morgan mill in Millwood had $10,000 in damages. County damage estimate: $735,000 to homes, farming operations and businesses. Berryville estimated damages: $70,000.

Table C-2. Winter Storm Hazard History	
Date	**Damages**
	Warren County: Melting snow plus rainfall carried debris, knocked down trees and electric poles, closed schools, and flooded homes and businesses. In Front Royal, a water line break drained 3 million gallons, flooding several roads, e.g. Commerce Ave. and Royal Ave. 200 Front Royal residents called about flooded basements and sewage backups. Flooding occurred along Happy Creek. Hardest-hit areas of the county were below where the North and South Forks of Shenandoah River converge. Subdivisions affected included Shenandoah Farms, Benny's Beach, Shenandoah River Estates, and Shenandoah Shores. 30-40 houses and structures were underwater. 7 families were evacuated. 125 Warren County residents applied for aid with FEMA. Shenandoah County: Rain and melting snow damaged roads and bridges, and washed out propane and fuel oil tanks from their places besides homes, in storage bins and in basements. Families were rescued from areas around Mill Creek, Stoney Creek, Edinburg and Mt. Jackson. Mt. Jackson had no drinking water. 110 county homes and Historic Edinburg Mill were severely damaged. Waters took 6 trailers from the Stoney Creek Campground in Edinburg. Large outbuildings and farm equipment were washed away. In Shenandoah County 122 roads and bridges were covered with water. Roads to Bayse were closed. Small bridge approaches were washed away and 5 swinging/footbridges were damaged. A Sinkhole occurred near Edinburg. Schools were out 8 days. 165 registered for help with FEMA. County agricultural damage was estimated at $4.1 million from washed out roads, destroyed fences, crop loss, top soil removed, farm equipment damaged. Road damages were estimate at $500,000 to $3.4 million.
February 2, 1996	The continuation of a strong upper-level jet streak, combined with additional mid-level dynamics, generated surface low pressure over central Georgia by evening on the 2nd. As the low moved to near Cape Hatteras overnight, a broad area of heavy snow overspread all of northern Virginia. Areas that received 4 to 13 inches during an early morning event (on the 2nd) picked up an additional 4 to 6 inches, leaving most areas from the central piedmont through the northern neck with a grand total of 12 to 18 inches. Farther north, from the Shenandoah Valley through the western suburbs of Washington, DC, 6 to 9 inches fell. Circulation around the surface system allowed arctic air to pour into the area during the heaviest snowfall. Much of the snow fell at temperatures below 20 degrees, making it powdery. The 6 to 9 inches were cleared from main arteries by the next afternoon, but side streets remained snow covered. The storm's exit ushered the coldest air in two years into the region. Daytime temperatures on the 4th remained below 20 degrees, with wind chill values ranging from 10 to 20 below zero. Light winds and clear skies, combined with relatively deep snow cover, allowed temperatures to fall to as low as 18 degrees below zero over portions of the western piedmont and northern Shenandoah Valley by dawn on the 5th. Records were set on consecutive mornings at Dulles International Airport (VAZ042, eastern section), with 10 degrees below zero on the 5th and 9 below on the 6th.

Table C-2. Winter Storm Hazard History	
Date	**Damages**
February 8, 1997	A winter storm dumped 4 to 8 inches of heavy, wet snow across all of northern and western Virginia on the 8th. Highest totals were observed above 2500 feet, with other local maxima in the Shenandoah Valley and the western suburbs of Washington, DC. Antecedent warm weather combined with air temperatures at or just above freezing during the event, allowed roads to remain generally wet. However, icy spots developed late that afternoon and evening as temperatures fell well below freezing. The snow, which clung to everything, was aesthetically pleasing. However, the weight of the snow snapped numerous tree limbs and knocked others onto utility lines. At the peak of the storm, over 10,000 Virginia Power customers in the Washington metropolitan area alone were without electricity. Otherwise, public impact was minimal since the storm occurred on a Saturday. The storm resulted from the interaction of the subtropical jet stream, which provided a strong energy impulse to aid in lifting relatively warm humid air, with the polar jet stream, which provided enough low-level cold air to maintain wet snow rather than rain.
December 29, 1997	A fast-moving and rapidly deepening low pressure system raced from the South Carolina coast to east of New Jersey in eight hours. An area of moderate to occasionally heavy snow developed over western North Carolina and raced through western Virginia during the afternoon and early evening. Accumulations ranged from 4 to 8 inches between the Blue Ridge and the Shenandoah Mountain range; between 8 and 14 inches in Highland County. Higher elevations throughout western Virginia received generally between 10 and 16 inches of snow. Blowing and drifting snow on the 30th created some travel headaches, but problems were minimal since the storm occurred during a period of low traffic between the Christmas and New Year's holidays. Accidents were few and far between, due to a combination of advanced warning and event time (a Monday evening). East of the Blue Ridge, a mix of snow and sleet accumulated between 1 and 4 inches, with values increasing with elevation. Minor travel problems were noted through the morning of the 30th. In the interior suburbs of Washington, DC, accumulations were generally an inch or less.
January 15, 1998	Warm moist air overrunning shallow polar surface air produced a variety of winter weather, starting around daybreak on the 15th and continuing just after midnight on the 16th. Precipitation began as a mix of sleet and snow but quickly changed to rain and freezing rain across much of the state. The combination of quick action by Virginia Department of Transportation road crews, and the still above freezing subsoil temperatures, kept most main arteries and secondary roads free from accumulation. However, in the ice storm area, free standing structures such as trees, power poles/wires, and exposed bridges received between 1/4 and 1/2 inch of ice accretion. A small section of higher elevation areas along and just west of the Blue Ridge received the most icing. In these areas, spotty power outages were noted, and several large limbs and small trees snapped under the weight of the ice. In forested areas of the northern Shenandoah Valley, specifically between 500 and 1000 feet above sea level, hundreds of trees sustained limb damage. Portions of the following counties were hit hardest: western Loudoun (VAZ042), Clarke (VAZ031), northern Warren (VAZ030), northern Shenandoah (VAZ027), and Frederick (VAZ028). Other pockets of substantial ice accretion likely occurred in Page, eastern Rockingham, and eastern Augusta Counties (VAZ025>026; 029). Power outages were rather scattered. In Clarke and Frederick Counties (VAZ028-031), three transformers blew due to ice accretion; several lines fell from the combination of fallen tree limbs and the weight of the ice. An estimated 200 Allegheny Power customers lost electricity. In the winter weather area, mixed precipitation quickly changed to rain during the late morning and early afternoon hours, but not before causing a minor build up of ice, along with early morning light coatings on area roadways.

Table C-2. Winter Storm Hazard History	
Date	**Damages**
January 27, 1998	A winter storm developed along the Georgia coast on the 27th, then intensified as it moved slowly northward along the coast later on the 27th and 28th. The cyclone, which tracked to the Virginia capes by late afternoon on the 28th, spread a variety of winter weather across the northern and central Shenandoah Valley during a 24-hour period. as had been the case with other episodes during the 1997/98 winter, accumulations varied greatly with elevation. From the Skyline Drive to the Shenandoah Mountain and North Mountain range, accumulations ranged from around 4 inches in the valleys to 8 inches above 1500 feet. West of the Shenandoah Range, in the plateau region of Highland Co (VAZ021), accumulations ranged from 12 to 18 inches. The weight of the snow caused numerous tree limbs and some trees to fall in areas where more than one foot of snow accumulated, mainly in Highland Co . Warmer air circulating around the storm caused a rain/sleet/snow mix over the northern Shenandoah Valley, where between 1 and 3 inches of wet snow accumulated. Similar accumulations were noted along the foothills just east of the Blue Ridge.
February 4, 1998	A powerful nor'easter, laden with deep moisture from the Gulf of Mexico and the Caribbean, produced a prolonged period of mixed snow, sleet, freezing rain, and rain across the northwest corner of Virginia. As had been the case with previous events, snow totals varied greatly with elevation. In most of the lower terrain, between 4 and 6 inches accumulated. Local high spots, such as Harrisonburg (VAZ026) and Waynesboro (VAZ025) received between 6 and 8 inches. Elevations above 2000 feet in the Shenandoah Mountains received between 8 and 16 inches of snow. One person perished from a heart attack while shoveling snow in Harrisonburg (VAZ026). The combination of heavy wet snow, and rain falling on top of it, caused a 50 by 80 foot area of roof to collapse at a food storage and distribution center in Lynnhurst (VAZ025). Considerable damage was sustained at a home in Waynesboro when a tree, weighed down by snow and ice, fell onto the roof causing a partial collapse. In Highland Co (VAZ021), 50 roads were closed due to blowing and drifting snow; some of the drifts were as high as 6 feet. The weight of the snow caused isolated power outages. The snow changed to a cold rain in lower elevations after noon on the 4th. The combination of wet snow, an old snow pack, and moderate rains produced local street flooding in Waynesboro and Staunton (VAZ025). There were scattered power outages as well. In Augusta Co (VAZ025), a reported 6000 customers were without power; 3000 were due to a failed substation in Dayton. Substantial ice accretion occurred at elevations above 2000 feet as surface temperatures remained just below freezing during moderate to heavy rains. The ice was 5 inches thick in some spots. The amount of ice accretion rivaled some of the fiercest storms in the past ten years, including those of the winter of 1993/94. Shenandoah National Park officials closed Skyline Drive for at least one week after the storm. In fact, park officials, employees, and volunteers spent the remainder of February clearing trees and debris. Damage was estimated to be $607 thousand in the Park alone. As of mid-April, there were still hundreds of trees to remove. Tens of thousands of trees and large limbs succumbed to the weight of the ice; the road itself was under at least 10 inches of ice and sleet. Power outages, though affecting relatively few customers in the high terrain, were widespread in those areas. Other problems were noted farther north, in Clarke, Frederick, and Loudoun Counties (VAZ028-031-042). In northwestern Loudoun Co, over one hundred trees needed to be removed from local roadways; school buses were delayed in the same areas. Between 150 and 175 customers were without power in higher terrain areas of northwest Loudoun Co. In Nelson Co (VAZ036), the Wintergreen ski and recreational resort area was closed on the 5th due to ice accretion.

Table C-2. Winter Storm Hazard History	
Date	**Damages**
February 4, 1998	A powerful nor'easter, laden with deep moisture from the Gulf of Mexico and the Caribbean, produced a prolonged period of mixed snow, sleet, freezing rain, and rain across the northwest corner of Virginia. As had been the case with previous events, snow totals varied greatly with elevation. Elevations above 2,000 feet in the Shenandoah Mountains received between 8 and 16 inches of snow.
December 23, 1998	A cold front swept across Virginia on the 22nd of December, ushering in sub-freezing air that set the stage for a mixed bag of precipitation the following day. On the 23rd, a weak upper level disturbance from the Gulf States moved quickly across the Mid Atlantic region, dropping between a trace and 2 inches of snow across Northern Virginia, in addition to a thin layer of ice and sleet. The combination of mixed precipitation, holiday travelers, and the first snowstorm of the season for drivers led to many traffic accidents. Interstate 81 was also treacherous, especially between Stephens City and Winchester in Frederick County. A tractor trailer tipped over on the I-81 ramp to U.S. Route 50, closing it from 3 to 11 PM, and two people were injured in a crash at the I-81 Millwood Pike bridge.
January 2, 1999	An area of low pressure moved from the Ohio Valley to the Eastern Great Lakes on the 2nd, spreading precipitation across the Mid-Atlantic region from midday on the 2nd to early morning on the 3rd. High pressure centered over New England brought a shallow layer of sub-freezing air to locations east of the Appalachian Mountains. Closer to the mountains this layer of cold air was deep enough to allow up to 5 inches of snow to fall. Just east of the West Virginia border, this layer of cold air was shallower, forcing a majority of the precipitation to fall in the form of sleet and freezing rain. Shortly after midnight on the 3rd, a warm front from the Atlantic Ocean moved into Central and Northern Virginia. Some locations in the foothills of the Appalachian Mountains, where the rapid warmup did not occur, had problems with icy roads for several days after the storm. Schools remained closed in Warren County through the 7th due to poor driving conditions.
January 8, 1999	An area of low pressure over Ohio brought a variety of precipitation to Northern Virginia. Precipitation started off as snow during the early morning hours of the 8th. By early afternoon warm air moved into the middle levels of the atmosphere turning the precipitation into freezing rain. The freezing rain continued through early morning on the 9th, when temperatures finally rose above freezing at the surface. Snowfall amounts included 9 to 10 inches in Highland County, 4 to 6 inches west of a line from Augusta County to Loudoun County and in Fauquier County, and 1 to 4 inches elsewhere. Ice accumulations on top of the snowfall ranged from a trace to 1/3 of an inch. The aftermath of the snow and ice included school closings and many car accidents. Over 200 traffic accidents occurred in the Washington D.C. metropolitan area leading to 27 injuries. The most serious accident occurred on the Dulles Toll Road where a jackknifed tractor trailer closed the road for an hour. Most metropolitan area schools were closed on the 8th. Interstates 66 and 81 across Northern Virginia were referred to as "treacherous" by law enforcement during the storm. Officials responded to 50 accidents along I-81 in Augusta County, mostly between mile markers 213-205 near Staunton. U.S. Route 29 was closed just south of Warrenton in Fauquier County because of a jackknifed tractor trailer and in Culpeper County due to several accidents. Snowfall up to 10 inches in Highland County made driving difficult, especially near Monterey.
January 14, 1999	A strong arctic cold front moved slowly southeast across the Mid-Atlantic region from late on the 13th to midday on the 15th. This front brought a thin layer of sub freezing air to the lowest levels of the atmosphere, but just off the surface warmer air moved in. A low pressure system developed on the 13th over the Tennessee Valley. The low moved into the Mid Atlantic region over the next few days, spreading precipitation region wide from early on the 13th through midday on the 15th. The precipitation started as snow but melted into rain as it fell through the warm layer of air in the mid levels of the atmosphere. Unfortunately west of the

Table C-2. Winter Storm Hazard History	
Date	**Damages**
	cold front the ground was below freezing during the period so the rain froze on every surface in came in contact with. This created ice accumulations of one quarter to one half inch north and west of a line from Loudoun County to Rockingham County through early afternoon on the 14th. By 9am on the 15th, ice accumulations from one quarter to nearly one inch occurred north of a line from Augusta County to Spotsylvania County. The ice this storm left behind had a large impact on the region. Hundreds of car accidents, slip and fall injuries, downed trees, and power outages were reported. A 28 vehicle pileup occurred on the Dulles Toll Road in Fairfax County at 10:30 PM on the 15th, and county officials reported 62 other accidents through sunrise on the 15th. Dozens of wrecks were reported in Clarke and Winchester Counties, including an overturned truck at the intersection of Interstates 66 and 81. In Stafford County, a jackknifed tractor trailer closed State Route 3 and 621, and Interstate 95 had to be temporarily shut down to clear fallen trees. An ambulance and fire truck ended up in a ditch after hitting ice in Shenandoah County. Loudoun County officials reported 37 accidents from 5 to 10 AM, including an accident that closed Snickersville Turnpike at Route 50 for two hours on the 15th. The icy conditions also led to over 500 pedestrian slip and fall injuries. One hospital in the Washington Metropolitan area treated over 250 patients alone with storm related injuries on the 15th. Winds gusted over 40 MPH after the precipitation ended and trees weighed down by the heavy ice accumulations fell on homes, across roads, and onto power lines across the area. Over 215,000 customers lost power from the storm across Northern Virginia, and Central Virginia reported over 6,000 additional outages. Several traffic signals across the area were out because of the power disruption through the 17th, causing additional traffic jams in the Washington D.C. suburbs.
March 4, 1999	A low pressure system moved from West Virginia to Pennsylvania on the evening of the 3rd. This system produced sustained winds of 25 to 40 mph from the afternoon of the 3rd through the morning of the 4th. A cold front associated with the system moved through during the early evening and produced a line of thunderstorms that brought heavy rain, small hail, and wind gusts in excess of 55 mph. In Shenandoah County, downed trees and power lines were reported across the county. 1,375 customers reported power outages. A roof was blown off an outbuilding in Fairview near Woodstock, and the top of an automated teller machine at the Strasburg Shopping Center was also blown off. Frederick County reported substantial damage to a large wall at the Rubbermaid Commercial Products Receiving Warehouse in Winchester. The wind also leveled several trees and signs. 6,000 customers reported power outages. The peak gust at the Winchester Airport was 42 mph. Greene County reported trees down across the county and downed electric poles near Eheart. Albemarle County reported power outages and small creeks and streams reaching bankful around 6:00 pm. Rappahannock County also reported trees down. Prince William County reported the windshield of a vehicle on Interstate 66 was blown out by high wind. In Dale City, several pine trees were also downed. After the cold front passed, temperatures dropped rapidly and rain turned to snow across Northern Virginia. Most locations received an inch or less of snow overnight, however Frederick County received 2 to 5 inches and a location on the Clark and Loudoun County line received 3 inches.

Table C-2. Winter Storm Hazard History	
Date	**Damages**
March 9, 1999	An area of low pressure moved from the Ohio Valley to North Carolina from late on the 8th through the evening of the 9th. Heavy snow fell across the Appalachian Mountains and the eastern foothills as the storm system moved through. In addition, the storm produced an unusual band of heavy snow that stretched in a west to east line from Frederick County to Fairfax County. This band was about 50 miles wide from north to south, and storm total snowfall was as high as one foot in this area. Snowfall rates were in excess of 1 1/2 inches per hour in many locations during the storm. By evening on the 9th Frederick, Clarke, Loudoun, Shenandoah, and Fairfax County received between 8 and 12 inches. Warren, Page, Northern Rockingham, Rappahannock, Prince William, and northern Fauquier County received between 6 and 10 inches. In Warren County, one person was killed in a car accident on Strasburg Road. The Winchester Airport in Frederick County was closed. In Shenandoah County, and early afternoon accident involving four tractor trailers closed part of Interstate 81 for four hours.
March 14, 1999	An area of low pressure over the Southeast U.S. produced snow across much of Northern Virginia on the 14th. Snowfall amounts were heaviest near the West Virginia border. Rain mixed with snow southeast of a line from Fairfax to Orange County. The low pressure system redeveloped off the coast of North Carolina and moved up the Eastern Seaboard on the morning of the 15th, resulting in another period of snowfall. Total accumulations included 7 to 12 inches in Page County, 5 to 10 inches in Shenandoah County, 5 inches in Warren and Clarke County, and 5 to 8 inches in Frederick County. T Several wrecks were reported on Interstate 81 in Shenandoah County.
January 20, 2000	An area of low pressure moved from west to east across the Mid-Atlantic region on the 20th, dropping 2 to 6 inches of snow between midnight and mid-afternoon. Gusty winds of 35 to 45 MPH developed during the afternoon causing the snow to drift across roadways and reduce visibilities in open areas. The first snowstorm of the season forced Washington National and Dulles International Airports to cancel one third of their morning flights. Several minor traffic accidents were reported across the region. In addition, three tractor trailers jackknifed on Interstate 81 during separate incidents in Rockingham and Augusta Counties. Snowfall totals included 3.6 inches at Washington Reagan National Airport, 5.5 inches in Warrenton, 6.0 inches in Winchester, 3.1 inches in Fredericksburg, 4.7 inches in Charlottesville, 5 to 6 inches in Monterey, 4 to 5 inches in Staunton, 4.7 inches in Boston, 4.5 inches in Stanley, 5.0 inches in Lovingston, and 4.0 inches in Harrisonburg.
January 25, 2000	Low pressure off Cape Hatteras rapidly intensified late on the 24th and developed into a nor'easter which tracked northward along the Eastern Seaboard on the 25th. Very heavy snow and near-blizzard conditions were seen throughout the day east of the Blue Ridge Mountains, resulting in extremely hazardous travel conditions. Wind gusts of up to 45 MPH were recorded and several roads were drifted shut by blowing snow. Numerous traffic accidents were reported and most airports and transit systems were shut down. A few people were treated for slip and fall injuries in Fairfax County. One man in Winchester was treated for heart problems after shoveling snow. Scattered power outages were reported in Loudoun County and Alexandria. The governor of Virginia declared a state of emergency as the storm battered the eastern part of the state. Snowfall totals ranged from 1 inch near the Blue Ridge Mountains to 15 inches near the Potomac River. New daily snowfall records were set at Washington Reagan National and Dulles International Airports. Snowfall totals included 9.3 inches at National Airport, 10.3 inches at Dulles Airport, 15.0 inches in Warrenton, 12.0 inches in Fredericksburg, 5 to 6 inches in Winchester, 6.0 inches in Stanley 8.5 inches in Front Royal, 6.5 inches in Charlottesville, 5.5 inches in Waynesboro, 4.6 inches in Somerset, 7.0 inches in New Market, 4.0 inches in Sperryville, and less than 1 inch in Staunton and Harrisonburg.

Table C-2. Winter Storm Hazard History	
Date	**Damages**
January 30, 2000	Cold air was in place east of the Blue Ridge Mountains on the 29th and 30th, keeping surface temperatures below freezing. Low pressure moved from the Lower Mississippi Valley northeastward to the Mid-Atlantic region early on the 30th, creating the perfect conditions for freezing rain around the Fredericksburg area, a mix of sleet and snow east of Skyline Drive, and moderate snowfall in the mountains. Ice accumulations between 1/4 and 3/4 of an inch coated roads, trees, and power lines in Fredericksburg and Stafford, Spotsylvania, and King George Counties. Electrical outages were reported as trees and branches weighed down by ice fell onto power lines. Disruptions affected 1000 power customers in Albemarle County, 125 customers in Orange County, and 3000 customers in Fredericksburg and Spotsylvania and King George Counties. A mix of sleet, freezing rain, and snow fell east of a line from Charlottesville to Arlington. Snow and sleet accumulations in this area ranged from 1 to 3 inches. West of this line, 3 to 7 inches of snow and sleet fell. Storm total accumulations included 1.2 inches at Washington Reagan National Airport, 6.4 inches at Dulles International Airport, 6.0 inches in Winchester, 9.0 inches in Luray, 6.5 inches in Warrenton, 2.5 inches in Manassas, 4.7 inches in Orange, 6.4 inches in Culpeper, 3.0 inches in Charlottesville, 6.5 inches in Staunton, and 7.0 inches in Monterey. Over 70 auto accidents were contributed to the storm, including two separate crashes in Loudoun County which killed a 59-year-old man and an 18-year-old woman. Significant flight delays were reported at National, Dulles, and Charlottesville-Albemarle Airports. Several train and bus routes were canceled or delayed. In Culpeper County, three horses suffering from hypothermia were rescued from a pond during the storm after falling through the ice.
February 18, 2000	Low pressure tracked from the Mid-Mississippi Valley to Pennsylvania on the 18th, spreading a mixed bag of precipitation north of a line from Harrisonburg to Washington D.C. Light snow spread into the area before dawn then changed to freezing rain by mid-morning. The precipitation changed to rain across the area by early afternoon. Several traffic accidents occurred on slippery roads. Scattered power outages due to ice accumulations were also reported in Rappahannock and Fairfax Counties. Ice accumulations included one half to three quarters of an inch in Frederick and Fauquier Counties, one quarter to one half inch in Loudoun, Fairfax, Prince William, Page, Greene, Rappahannock, Culpeper, Clarke, Madison, and Shenandoah Counties, and less than one quarter inch in Rockingham and Albemarle Counties. Snowfall amounts ranged from a trace to 2 inches.
December 13, 2000	A strong cold front brought chilly air into the region on the 12th. By the afternoon of the 13th, an upper level disturbance brought warm air into the mid levels of the atmosphere and caused snow that fell from the system to melt to rain on its way down. When the rain hit the ground where temperatures were below freezing, ice accumulated. Across the Shenandoah Valley and much of Northern Virginia, the ice accumulated to between one quarter and three quarters of an inch. The weight of the ice brought down some trees, branches, telephone lines, and power lines. Nearly 50,000 customers lost power across Northern Virginia for a short time. Roads were turned into sheets of ice and several traffic accidents were reported. Along the Interstate 81 corridor, law enforcement advised drivers to remain at home overnight after road conditions rapidly deteriorated. Near the Potomac River south of Washington D.C. and across the Central Piedmont, temperatures remained closed to the freezing mark so ice accumulations were less than one quarter of an inch and only caused minor inconveniences.
December 19, 2000	Low pressure moved across the region on the 19th and produced periods of light to moderate snow between 4 AM and 8 PM. Snowfall totals ranged from 2 to 6 inches with the highest amounts falling along the Blue Ridge Mountains and across the Shenandoah Valley. Several traffic accidents were reported during the evening commute after roads became snow covered. After the snow ended, northwest winds gusted up to 30 MPH which caused some of the snow to drift back onto plowed roads overnight.

Table C-2. Winter Storm Hazard History	
Date	**Damages**
January 20, 2001	A complex low pressure system moved across the Mid-Atlantic region on the 20th and 21st and bright a mixed bag of precipitation. Across the central and northern Piedmont, the precipitation fell mainly as rain but mixed with freezing rain, sleet and light snow on the 21st. Little if any accumulation was reported. Elsewhere across the northern third of Virginia, rain fell through the afternoon of the 20th but changed over the sleet and snow from west to east during the evening. Snowfall continued overnight and ended between 4 AM and noon on the 21st. Snowfall accumulations ranged from 2 to 4 inches across the Shenandoah Valley, 3 to 6 inches near the Blue Ridge and Catoctin mountain ranges, and 1 to 3 inches elsewhere. Isolated reports of thunder, snow and snow accumulation rates of one inch per hour were received. The snow and sleet caused area roads to become slippery and several traffic accidents were reported, including one incident where a man was killed on Interstate 81. Gusty northwest winds blew during the afternoon of the 21st which caused wind chills to dip to near zero and blew some snow back onto freshly plowed roads. Wind gusts included 43 MPH at Dulles International Airport and 45 MPH at Washington Reagan National Airport.
February 22, 2001	Low pressure moved from the mid Mississippi Valley into the southern portion of the Mid Atlantic region on the 22nd. This system produced mainly light to moderate snowfall across the region between 9 AM and 10 PM. However, some areas received a brief period of heavy snow at the beginning of the event which created whiteout conditions. Snowfall amounts ranged from 2 to 5 inches. The highest amounts were recorded in the vicinity of the Blue Ridge Mountains. Although the snowfall accumulations were relatively minor, numerous traffic accidents were reported that involved hundreds of vehicles and numerous injuries. Six separate accidents were reported on Interstate 81 in Frederick County. Twenty accidents were reported in the City of Winchester. Frederick County school buses slid off the road around midday as they tried to take students home from school.
January 6, 2002	Low pressure moved from the Gulf Coast through the Eastern Seaboard on the 6th and brought a mixed bag of precipitation to the region. From the Blue Ridge west, the precipitation fell mainly in the form of snow with a period of sleet and freezing rain at the onset. The Shenandoah Valley received a few hours of freezing rain at the beginning of the event which resulted in several accidents. One hundred wrecks were reported on Interstate 81 between southern Rockingham County and northern Shenandoah County. Multi-car crashes temporarily closed the southbound lanes of I-81 near Mount Crawford and Woodstock. East of the Blue Ridge, a mix of rain, freezing rain, and sleet changed over to snow and sleet late in the day. In Shenandoah County, accumulations averaged around 4 inches. In Frederick County, accumulations ranged from 4.5 to 6 inches. In Page County, snow and sleet accumulations averaged around 2 inches. In Warren County, about 1.5 inches of snow and sleet was reported. In Clarke County, about 1 inch fell.
December 24, 2002	Low pressure passed directly over the region between the evening of the 24th and midday on the 25th. This system brought a mixed bag of precipitation including snow, sleet, rain, and freezing drizzle. The largest snowfall totals occurred in the Northern Shenandoah Valley and across the Northern Virginia suburbs of D.C. where between 2 and 4 inches was reported. Across the Central Shenandoah Valley, freezing drizzle and rain were the primary weather types. Patchy ice was reported on roads and sidewalks. Only a slushy inch of snow and sleet was reported. The amount of snow that fell from this storm was enough to give the region an official "White Christmas".

Table C-2. Winter Storm Hazard History	
Date	**Damages**
February 14, 2003	A complex storm system produced copious amounts of wintry precipitation across the northern third of Virginia between the evening of the 14th and midday on the 18th. The first batch of precipitation fell between the evening of the 14th and the evening of the 15th in the form of light to moderate snow or rain. The second batch of precipitation fell between midnight on the 16th through midday on the 17th in the form of heavy snow or sleet. The third batch of precipitation on the back side of the storm fell between the evening of the 17th and midday on the 18th in the form of scattered snow showers. After the precipitation came to an end, record breaking snow and sleet accumulations were reported. Across the Northern Shenandoah Valley and the northwest Virginia suburbs of Washington D.C., accumulations of mainly snow ranged from 20 to 36 inches. In Page County, a chicken house collapsed in Dovel Hollow. In Shenandoah County, two homes, one carport, 7 business buildings, 3 public buildings, and 7 agricultural buildings (including 5 animal shelters where a total of 61,000 turkeys and chickens were lost) suffered structural collapses. Twenty people who lost their homes were sheltered by the Red Cross. Near Edinburg, a 38-year-old man who was sitting in a snowbound car died of carbon monoxide poisoning. An 82-year-old man near Conicville died from a heart attack after trying to cross through deep snow to feed livestock. In Frederick County, officials reported $1.4 million in structural losses. Four mobile homes, a park maintenance building, a commercial storage building, a barn, an industrial building, a church, and two stores suffered collapsed roofs. A nursery north of Winchester suffered the loss of 9 of 21 large greenhouses. A 76-year-old woman from Stephens City suffering from dementia was found dead from exposure a week after the storm ended buried under one foot of snow. In Clarke County, 2 hay barns and a machine shed collapsed. In Warren County, the roof of the North Warren Fire Station collapsed. Many other smaller structures including porches, garages, and carports collapsed across the county. Two men, ages 82 and 57, died of heart attacks while shoveling snow.
February 16. 2010	On January 11, 2010, Governor Timothy M. Kaine requested a major disaster declaration due to a severe winter storm/snow event during the period of December 18-20, 2009. The Governor requested a declaration for Public Assistance, including snow removal assistance, for 30 counties and 10 independent cities; Public Assistance for 48 counties and 7 independent cities; and Hazard Mitigation for the entire Commonwealth. During the period of January 15-29, 2010, joint Federal, Commonwealth, and local Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the Commonwealth and the affected local governments, and that Federal assistance is necessary.

Table C-2. Winter Storm Hazard History	
Date	**Damages**
April 27, 2010	On March 12, 2010, Governor Robert F. McDonnell requested a major disaster declaration due to severe winter storms and snowstorms during the period of February 5-11, 2010. The Governor requested a declaration for Public Assistance for 71 counties and 12 independent cities; Public Assistance, including snow assistance for 19 counties and seven independent cities; and Hazard Mitigation for all jurisdictions. During the period of March 8 to April 2, 2010, joint Federal, Commonwealth, and local Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the State and the affected local governments, and that Federal assistance is necessary.
March 7, 2016	On February 19, 2016, Governor Terence R. McAuliffe requested a major disaster declaration due to a severe winter storm and snowstorm during the period of January 22-23, 2016. The Governor requested a declaration for Public Assistance, including snow assistance for 20 counties and five independent cities and Hazard Mitigation for the entire Commonwealth. During the period of February 8-18, 2016, joint federal, commonwealth, and local government Preliminary Damage Assessments (PDAs) were conducted in the requested areas and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the commonwealth and the affected local governments, and that Federal assistance is necessary.

Table C-3. Flood Hazard History	
Date	**Damages**
September 1870	*(Source: The Clarke Courier and The Warren Sentinel)* From September 28th to September 30th, a severe storm system entered Virginia producing heavy rains and major flooding **Page County**: This event produced the worst flooding from the Shenandoah River. The high water mark for the Shenandoah River was 30 feet, 28 feet at Rileyville, 48 feet at Riverton and 37 feet at Castleman's Ferry Bridge. The flooding caused 12 fatalities. **Clarke County**: 23 buildings were washed away from Castleman's Ferry during this flood. Buildings included several dwellings, a tailor shop, blacksmith shop, warehouse, ice house, ferryman's house, a stable, mill and a large warehouse. This community was wiped out and didn't return.
1870-1896	*(Source: The Warren Sentinel and The Clarke Courier)* **Page County**: In 1877, The Shenandoah River high water mark was 41 feet at Riverton, 25.5 feet near Rileyville, 29.5 feet at Castleman's Ferry Bridge 1889 (The Johnstown Flood) The Shenandoah River high water mark was 36 feet at Riverton, 29 feet at Castleman's Ferry 1896 The Shenandoah River high water mark was 34.2 feet at Riverton, 22 feet near Rileyville

Table C-3. Flood Hazard History	
Date	**Damages**
May 12, 1924	*(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley, The Shenandoah Herald, The Winchester Evening Star and The Warren Sentinel)* On Monday, May 12th, a severe storm system entered Virginia producing heavy rains continuing into Thursday, May 16th. **City of Winchester**: 8.3 inches of rain fell. **Page County**: The Shenandoah River crested at 30 feet above the low water mark at Castleman's Ferry Bridge. The high water mark of the Shenandoah River was 34.6 at Riverton, and 22 feet near Rileyville. The river rose over 15 feet at Shenandoah. The Shenandoah River washed away fences, trees, poles, livestock and roads. The Hawksbill reached a height of 7 feet at Luray; the highest in 30 years. On Water Street on the North side of the Hawksbill bridge the water reached the middle of the street. Many residents along Water Street left. Water inundated all of the cellars of the restaurants and businesses at the Hawksbill bridge. Buildings along the Hawksbill suffered the loss of minor articles. Homes were surrounded by water and several residents had to be rescued by boats. After the waters receded between 75 and 100 skeletons were found, believed to be bones of Indians. At Grove Hill estimated damages to crops was $25,000. **Warren County**: The river crested over 34 feet. This event caused the biggest flood since 1889. The Shenandoah River flooded fields, washed away fences and topsoil, ruined crops, damaged bridges, and some livestock were lost. Both hydro-electric plants in Front Royal and Shenandoah were submerged, trains were re-routed. The county bridge over the South River was impassible and the Riverton Lime Company bridge was carried away. **Shenandoah County**: Shenandoah County was the center of the flooded region. The Shenandoah River and its' tributaries, Smith Creek, Mill Creek, Stony Creek, Pughs Run, Narrow Passage and others overflowed producing much damage that paralleled storms of 1870, 1877 and 1896. The river rose 38 feet at Strasburg **Clarke County**: Berryville was without water due to a break in pipes. Mail was suspended and trains cancelled or delayed. Water levels were at the second story level in some places.

Table C-3. Flood Hazard History	
Date	**Damages**
May 12, 1924 (cont.)	**Shenandoah County**: The Shenandoah River had not been this high in Mt. Jackson since 1895. The Red Banks bridge in Mt. Jackson was lifted and washed downstream making Valley Pike impassible, stranding cars. Estimated damage to this bridge $25,000. Meem's Bottoms south of Mt. Jackson was covered with 6 feet of water. Flooding was bad at Rawley Springs where the Dry River left its banks. Cottages along Gum Creek were surrounded by water. Two floods hit Bridgewater 12 hours apart. The first flood from the North River overflowed its banks by 12 feet, the second overflowed Dry River and the Shenandoah River 8 feet over its banks. The Humston and Clinedinst county bridges, the Neff Bridge, the Snapp Bridge in the Madison district, the Santmiers bridge from Edinburg to Powells Fort, the bridge across Stony Creek and the Rude Hill Bridge were damaged. The Narrow Passage bridge was gone. Many miles of the B&O tracks between Harpers Ferry and Cumberland were suspended. Norfolk and Western rail tracks at Riverton, Grottoes and Elkton were washed away. The C&W Railroad bridge at Elkton was gone. The road from New Market Bridge was under water as far as Plains Mill. New Market was without lights. In Edinburg the Triplet power plant was swept away. Two hydro-electric plants on the Shenandoah River were damaged, one almost swept away and the other submerged and damaged. Power plants at Weyers Cave, Bridgewater and Shenandoah City were damaged. Electricity was out in Timberville electric out due to damage its' electric plant. A section of the Taylortown dam swept away. Damage to roads in the Shenandoah Valley estimated at $500,000. **Frederick County**: At Winchester there was substantial flooding at the town library and cellars along Main Street. The northwest section of Winchester was without power. The Opequon Creek overflowed its' banks carrying debris and flooded lowlands. Railroad operations were suspended and later detoured due to washed out tracks.
March 17, 1936	*(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Herald, The Winchester Evening Star and The Warren Sentinel)* On Monday, March 17th through Tuesday, March 18th a severe storm system entered Virginia producing heavy rains, 3.69 in Winchester, and 25 feet above flood stage in Page County. The river crested at 33 feet at Castleman's Ferry by Berryville and 39 feet at Riverton. Many bridges along the Shenandoah, Potomac and Ohio Rivers washed away during this event. **Clarke County**: The Shenandoah River rose to a height of 35 feet above its normal level. Damage was primarily due to flooded cellars of homes and businesses. In Boyce, the water level reached first floor level. Farms were damaged along banks at Berry's Ferry. Travel from Boyce to Winchester and Berryville was cut off. The Castleman's Ferry bridge and the Millwood-Boyce Highway were closed to traffic. Railroad tracks at Riverton were washed out, stopping service. Electric and telephone service were interrupted for a few hours. **Page County**: 3.10 inches of rain reported. Bridges and highways had the greatest damage. The Alma bridge across the Shenandoah River, 8 miles west of Luray was partially destroyed by floating debris, damage estimated at $8,000. Most footbridges in the county were washed away. The banks of a new reservoir were damaged and the road to Luray High School was unfit for travel. Parts of the Eastside Highway were washed away. Several secondary roads along the Hawksbill River were covered with water. Water reached homes along this river and carried away livestock, barns and outbuildings. Many residents left their homes. Railroads (N&W and Chesapeake & Western) had heavy losses. Rail service was disrupted from several washouts. Page Power Company plants were out of commission for awhile. 15-20 electric/telephone poles fell. Most towns with the exception of Luray were without power. Crops and livestock were lost. County damage estimate: $100,000 with $75,000 in road damages. **Warren County**: Streets and alleys in Front Royal were flooded from Happy Creek. 50% of Main Street was flooded with many stores and cellars. The

Table C-3. Flood Hazard History	
Date	**Damages**
	bridge between Luray and New Market and approaches to the Shenandoah River bridge at Riverton were washed away. There were mudslides on Skyline Drive between Panorama and Front Royal. The Warren Power Company plant below Riverton was 2/3 underwater. Routes 50 and 11, south of Cedar Creek along with Routes 55, 3, and 12 were damaged. **Frederick County**: The Hayfield bridge and surrounding 500 acres were flooded. Schools were dismissed. In Winchester there were washouts near Cedar Creek damaging Smith's Park and the bridge at the Norfolk & Western Rail station. Rail tracks were washed out. Mail, rail and power services were out. Almost every home and street close to the Shenandoah River had some flooding. Cedar Creek, Opequan Creek, Isaacs Creek, Hogue Creek, Parlett's Run, Mill creek at Millwood and other streams overflowed and were at their highest levels in years. Footbridges were washed out. **Shenandoah County**: Flooded houses were left with silt/sand and debris. Damages included highway washouts, downed fences telephone/electric poles and fences, small buildings and topsoil washed away. The bridge across Stoney Creek was submerged and the bridge leading to Shenandoah Caverns was washed away. The bridge across the Shenandoah River between Strasburg and Front Royal was destroyed. Several bridges north of Mt. Jackson were submerged. Farms along the Shenandoah River were hit hard. Also hard hit were Meem's Bottom, south of Mt. Jackson, Woodstock and along Spring Hollow. New Market, Mt. Jackson, Edinburg and Woodstock were without power. Part of the Woodstock Electric Light and Power Company was washed away and sections were damaged. Homes were evacuated in Woodstock and at "White Haven." In Woodstock, several footbridges over the Shenandoah River were washed away. Almost every home in Woodstock had flooded basements and one home was swept away. At Taylortown and Edinburg, hydro-electric plants were washed away. Other areas mentioned included Narrow Passage Creek, Red Banks, Mill Creek and Mt. Clinton.
October 13-16, 1942	*(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley, The Winchester Evening Star and The Warren Sentinel)* From Tuesday, October 13 to Friday, October 16, a severe storm system entered Virginia. All counties in the region had crop damage of 50% for apples. **Clarke County**: Storms produced 13.5 inches of rain, 5.34 inches in Timberville, the Shenandoah River crested at 48 feet. This event flooded crop land, houses, barns, outbuildings. Outbuildings, shacks, cabins, barns and their contents were swept away. Virtually all homes had water damage from water in basements to water reaching second floors. Orchards, livestock and farms had significant losses. Topsoil was scoured from fields leaving silt and mud. Fences and trees were toppled. Secondary roads were impassible and the bridge at Berry's Ferry was covered with water. Schools were closed two days. Mail service was interrupted and schools closed for two days. County estimated damages: $500,000. **Shenandoah County**: Rain accumulation totaled 14 inches. **Warren County**: 16 inches of rain fell in Front Royal. This event overflowed the Shenandoah River and Happy Creek flooding acres of low-lying areas and was in the second story of many buildings. Castleman's and Berry's Ferry Bridges were under water. Front Royal was hard hit. A water main crossing Happy Creek ruptured. 450 residents along Happy Creek near Front Royal and Riverton had to be rescued. At least 45 basements were pumped of water. Telephone service, water and power were out at Front Royal. Facilities of the Front Royal Recreational Park had $10,000 in damages. 25,000 rods of fencing damaged. High waters submerged the Luray Turnpike by Riverside, the N&W Railroad Station and the Southern Station at Riverton. This event devastated the Riverton Lime and Stone Company.

Table C-3. Flood Hazard History	
Date	**Damages**
	City of Winchester: 13.41 inches fell in Winchester. Major stores and businesses were flooded. Downtown streets were flooded and the Town run overflowed. Railroads were suspended and later detoured. Almost all roads into Winchester were closed. **Frederick County**: The corn crop and livestock were heavily damaged. Schools were closed. In Winchester, The dam at Bartonsville was damaged. **Page County**: Overflowing streams and creeks washed out numerous bridges and highways. The Shenandoah River rose over the Eastside Highway to the first floor of a milling company and undermined approaches to the Alma Bridge. The Hawksbill Creek at Luray reached the highest crest on record. At the bridge in the center of town, the creek was up 17 feet, reaching the window sill of a nearby building and flooding North broad Street to a depth of 3-4 feet. Several families were homeless. Homes, livestock, businesses, outbuildings, fences, steel storage tanks, storage buildings were swept away. Heavy damage to the Main Street Bridge over the Hawksbill Creek in Luray when gas tanks washed against the bridge. Banks along this bridge were severely undermined, causing structural damage to businesses in the vicinity. Water in Luray had to be sterilized. 48' of a water main under the Main Street Bridge was washed away. Crops were severely damaged. Businesses like the restaurant at Hawksbill bridge in Luray flooded. Outbuildings at Marksville along the Pine Grove Creek were washed away in addition to portions of the road from Stony Man to Ida. Schools were closed two days. Power was out for 24 hours. County damages estimated at $200,000 in livestock and property damages. **Shenandoah County**: This event produced major agricultural losses to crops and livestock. Houses, outbuildings, secondary roads and bridges were washed away. The bridge to Shenandoah Caverns was carried away. Sections of US 11 between New Market and Winchester were flooded along with adjacent farms in Mt. Jackson. Red Banks, near Edinburg was overflowing. Approaches of two bridges to Strasburg were swept away. New Market, Edinburg, Mt. Jackson and Woodstock were without power. At Timberville many homes and businesses were without electricity, telephone and water service. Water pipes were washed away. Livestock and crops were lost, fences were down and pastures were covered with silt and debris. Water entered homes to first floor level. Three sizeable steel bridges were carried away. Schools were closed for two days. Naked Creek flooded Verbena causing $8,000 in damages. Shenandoah had the worst flooding from this event, knocking out power, railroad service, flooding roads and knocking homes off foundations.
July 15, 1951	*(Source: Shenandoah Herald, The Shenandoah Valley, The Warren Sentinel and The Winchester Evening Star)* Sunday evening July 15th a severe storm with high winds, hail and thunder entered the region and swept over parts of Warren, Shenandoah and Frederick Counties producing 5 inches of rain in Timberville and 2 inches in Woodstock. This event damaged southern and western parts of Woodstock and produced the worst flooding in years. Basements and cellars were flooded. Businesses had water damage and a barn was destroyed by fire from lightning. Trees fell and there was damage to orchards and crops. The Virginia Electric and Power Company had 10 inches of water. In Timberville, the rain washed fields, gardens and roads. In Forestville, high waters covered bridges and roads and washed away flood gates, gardens, cut wheat and trees. In the White Hall section near Winchester this event ripped roofs from buildings, twisted houses on their foundations, knocked down telephone lines and virtually destroyed farm crops in a two-mile area. Lighting caused building fires in Front Royal.

Table C-3. Flood Hazard History	
Date	**Damages**
	This event affected the following towns: White Hall, Timberville, Front Royal, Forestville, Quicksburg, Conicsville and the Fort Valley section of Shenandoah east of Strasburg.
October 15, 1954	*(Source: The Clarke Courier, Page News and Courier, Shenandoah Valley, The Warren Sentinel and the Winchester Evening Star)* On October 15th Hurricane Hazel entered the region producing strong winds with gusts up to 40 mph and 9 inches of rain at Shenandoah National Park, 11.20 inches at Big Meadows and 4.05 inches in Winchester. High waters made roads impassible for a time. **City of Winchester**:: 10-50% of the apple crops in Winchester were damaged. **Clarke County**: The Shenandoah River rose over the 6 ft marker at Bixler's Ferry Bridge, 12 to 15 feet higher than normal by Berryville. In Berryville, water flooded Main and Church Streets Approximately 15% of the apple crop reported damaged. Livestock (poultry) was also reported as a loss. **Shenandoah County**: Damage to apple orchards and livestock was reported. **Frederick County**: Approximately 15% of the apple crop reported damaged. Also reported was livestock loss, mostly poultry. **Page County**: minor and some major damage were reported. This storm caused several creeks (i.e., Hawksbill and Dry Run) to overflow, uprooting trees, knocking over fences, scouring roads and washing out parts of bridges. The Luray Sewage Treatment Plant had $1,000 in damages from the overflowing Hawksbill Creek, which also covered US 340 north and south of Luray and carried debris. Many county roads were impassible from high waters and submerged cars. Fallen trees damaged power wires. Stanardsville had major wind damage, with fences, chimneys, antennas, and trees down with debris along the highways. **Warren County**: this storm event produced losses in livestock, mostly poultry.

Table C-3. Flood Hazard History	
Date	**Damages**
August 12, 1955	*(Source: The Clarke Courier, The Page News and Courier and The Winchester Evening Star)* From Thursday evening, August 11th to Saturday, August 13th, Hurricane Connie entered Virginia producing minor winds up to 30 mph and rains of 4.71 inches in Clarke County, 3.57 inches at Shenandoah National Park, 6.37 inches at Big Meadows and 6.42 inches in Winchester. The Shenandoah River rose 6 feet above its normal level. **Clarke County**: Damage from this event was fairly light. Corn, apples, peaches and trees were knocked down. Power and telephone service was disrupted. Electricity to Berryville was out for several hours. Fields, secondary roads and roads along the Shenandoah River were flooded. **Page County**: Some mountain streams reached flood stage. Rocky Branch washed out sections of roadway. Trees, crops, power lines and antennas were knocked down. There was some livestock loss. **City of Winchester**: This event knocked down trees, blocking roads and causing some power and telephone outages. There was minor crop damage. Two injured and an automobile overturned.

Table C-3. Flood Hazard History	
Date	**Damages**
August 19, 1995	*(Source: The Clarke Courier, The Page News and Courier, The Winchester Evening Star and The Warren Sentinel)* On Wednesday evening, Hurricane Diane entered Virginia producing minor winds up to 40 mph and 2.98 inches of rain in Clarke County, 10.33 inches at the Shenandoah National Park and 11.48 inches at Big Meadows on the Skyline Drive. The Shenandoah River crested at 29 feet in Clarke County, 29 feet at the Northern & Western Bridge in Warren County, 17 feet by Luray, and 19.9 feet by Berry's Ferry on Route 50. **City of Winchester:** Winchester was cut off to west and south as main highways were underwater. **Frederick County**: Basements in Middletown were flooded. US Route 11, Route 12, Route 522, and Route 50 were closed. **Shenandoah County**: The Naked Creek caused significant damage to Verbena. One person drowned in the Shenandoah River near Strasburg. In Woodstock, a break in waterlines compromised the water system. Serious basement flooding occurred at Woodland, Opequon and Berryville Avenue in Woodstock. **Clarke County**: Since the ground was saturated from Hurricane Connie, waters flooded low lying pastures, fields and river roads. Fences were torn down and crops of corn, beans, tomatoes, and watermelons were ruined. Watermelon Park was damaged, several cabins were damaged but, with one exception, no houses were flooded. Telephone service was disrupted and the receding river left much debris. Damage was estimated in the thousands of dollars. **Page County**: 25 residents left their homes along the Hawksbill Creek. Property, livestock and highways had damage. Secondary highways were hard hit. Damaged areas cited included Shenk and Beahm Hollows by Rocky Branch, east of Luray in the Dry Run watershed and in the Ida section. Highway damage was estimated at $50,000, not including replacing the Naked Creek bridge. Livestock damage was estimated at $100,000. County damage estimate: $150,000. **Warren County**: This event flooded some roads, produced minor crop damage and minor power outages. Main damage was from sewage overflow into basements. Hard hit were the Front Royal Country Club and the Guilford Electrical Contractors property near Passage Creek. Several homes were flooded in Front Royal and Riverton areas.

Table C-3. Flood Hazard History

Date	Damages
May 23, 1959	*(Source: The Clarke Courier and The Winchester Evening Star)* On Saturday afternoon, May 23rd, a severe storm system entered the region producing minor rain but strong winds. This event was the second storm within a week and produced 2-3 inches of rain in northern Frederick County and 0.21 inches in Clarke County. This storm came from the northwest and swept into Clarke County, passing between Winchester and Martinsburg, WV with the worst in Stephenson, VA. **Clarke County**: This event blew off the roofs of both a house and a barn and caused damages to public utilities, trees, chimneys, and antennas. Telephone service for 200 residents was disrupted and a traffic light was out. **Frederick County**: Power and telephone services were interrupted. Lightning struck a barn at Longwood, north of Millwood. Hail smashed windows, damaged orchards and knocked down trees. Roads flooded included Route 671, Route 11, and Route 664. Noted areas of damage: White Hall, Stephenson and Burnt Factory.
October 1, 1959	*(Source: The Clarke Courier, Winchester Evening Star and Warren Sentinel)* On October 1, a downgraded Hurricane Gracie entered the region producing 2.03 inches of rain in Clarke County, 2.29 inches in Winchester, 2.05 in Berryville and 0.56 inches in Warren County. **City of Winchester**: This storm event produced no serious damage, however roads were temporary covered. There were minor power outages and 200 telephone lines were knocked out. No other information was provided on this event.
September 23, 1969	*(Source: The Clarke Courier)* On September 10th a storm system entered the region producing 3.37 inches to 4 inches of rain. **Clarke County**: Creeks and rivers overflowed their banks flooding lowlands, secondary roads and basements. Roads in White Haven and Route 7 east of Barryville were flooded.
June 11, 1970	*(Source: The Clarke Courier and Page News and Courier)* A storm system entered Virginia producing 2.38 inches of rain in Clarke County and 2 inches in Page County. **Clarke County**: This event produced one of the hardest rains in years in Berryville, flooding some stores along the south side of Main Street. **Page County**: This event produced large hailstones, briefly cut power in some areas, washed through low-lying areas and flooded some basements. No major damage was reported.

Table C-3. Flood Hazard History	
Date	**Damages**
July 10, 1970	*(Source: The Clarke Courier, The Page News and Courier and The Winchester Evening Star)* A storm system entered Virginia producing 4.28 inches of rain in Berryville, 2.55 inches in Winchester and 4 inches in Luray. The Shenandoah River rose 3 feet in Riverton. **Clarke County**: Rain flooded streets in Berryville, flooding cellars and overflowing the town run. Main Street in Berryville and Route 7 east of Berryville were blocked. A bridge on Route 522 was washed away. **Warren County**: A small tornado went through Massanutten Camp Forest near Front Royal producing $2,000 in damages. Cedar Creek flooded roads. **Page County**: Basements were flooded, some crops and fields were damaged and roads washed out heavily in places. Several Luray Streets were flooded.
August 20, 1970	*(Source: The Clarke Courier and Page News and Courier)* A storm system entered Virginia producing 2.74 inches to 5 inches of rain in Clarke County and 4 inches in Page County. **Clarke County**: This event caused flooding in Berryville and along streams in the county. Main Street was flooded for the third time that year. **Page County**: Parts of Page county was flooded with the most damage done in Dovel Hollow near Stanley. Roads were scoured and the Hawksbill creek covered a bridge south of Luray.
November 14, 1970	*(Source: The Clarke Courier and The Winchester Evening Star)* A storm system produced flash flooding in this region with 3.21 inches in Winchester and rising the Shenandoah River 10 feet. **Clarke County**: Basements, yards, and low lying areas were flooded. The Opequon and Cedar Creeks overflowed their banks and flooded homes. On Route 50 a car washed away and the occupant was rescued. **City of Winchester**: Two cars were swept off the road. Sensev Road had a mudslide, basements were flooded, and a restaurant was damaged. About $20,000 in damages was done to the Izaak Walton League Park on Route 50, and the city sewer lift station was damaged. Homes along Sulphur Spring Road and Babb's Run were flooded. A few outbuildings were washed off foundations and low-lying bridges were submerged.

Table C-3. Flood Hazard History	
Date	**Damages**
June 23, 1972	*(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley, The Warren Sentinel and The Winchester Evening Star)* On June 20th through June 22nd, Hurricane Agnes entered Virginia producing 6.07 inches of rain in Clarke County, 8.15 inches at the Shenandoah National Park, 13.35 inches at Big Meadows atop the Blue Ridge, 6.55 inches in Front Royal, and 8.09 inches in Winchester. **Clarke County**: Hurricane Agnes flooded lowlands, including summer retreats at Shenandoah Farms and The Shenandoah Retreat. 50 families from Shenandoah Farms were evacuated. At this location 13 structures were destroyed. Areas with damages included White Haven, Bradfield Subdivision, Riverside Rendezvous and Watermelon Park. Many cellars were flooded. 11 roads were closed. Two were trapped on an island in Passage Creek. The receding river left much silt and debris. Losses in the county were estimated to be in the thousands of dollars. The Shenandoah River crested at 21.5 feet. **Warren County**: Areas adjacent to either fork of the Shenandoah River were underwater for days. Happy Creek, South Fork, and Passage Creek overflowed. Riverton was flooded. This event completely destroyed 21 homes, seriously damaged 150 homes, and left 50 homes with minor damage. 14 homes in Shenandoah Farms, 4-5 homes in Mandalay, 2 homes in Shenandoah Shores, 2 homes and 5 trailers at Avalon Shores in Riverton were lost to flooding. Bridges at Bentonville and Morgan's Ford were underwater. Telephone service was out. The biggest problem was backed up sewage. People got typhoid shots. There was no drinking water. County damage estimate: $1.5 million. The Shenandoah River rose 29.56 feet in Warren County, **Page County**: This hurricane produced the worse flood in 30 years causing heavy damages to buildings, fences, roads, bridges, culverts, farmlands and crops near the Shenandoah River, the Hawksbill Creek and in low-lying areas. More than 30% of crops were damaged. Several permanent homes, vacation homes, trailers and poultry houses were damaged. Campgrounds and summer homes along the Shenandoah River were nearly covered. Residents along the Shenandoah River, Hawksbill Creek and other streams were evacuated in addition to residents of the Brookside Subdivision in East Luray. More severe damage was done to small bridges, roads, and culverts in part of the county. The Hawksbill Creek severely damaged the Linden Avenue and Dyche Bridges in Luray and carried a truck downstream. Roads in Luray and Shenk Hollow were washed out. Shenandoah's water treatment plant was out of service. Most heavily damaged section was the Pine Grove area near Stanley. There was one fatality. Luray damage estimate: $25,000. County damage estimate: $100,000, in farm and crop damage.

Table C-3. Flood Hazard History	
Date	**Damages**
June 23, 1972	*Cont.* **Shenandoah County**: This event flooded low farm lands and blocked major and secondary roads. There was some agricultural and livestock damages. Over 78 highway locations had damage from stream crossings and with debris and mudslides at several locations. Ditches were washed out and debris/silt/stone was deposited on roads. There was a large mudslide in the Zepp area of western Shenandoah County. Cedar Creek damaged a wayside and spread debris over several roads. Meem's Bottom road, Redbanks Bridge and U.S. 11 were covered. County damage estimate: $106,000 with damage mostly on secondary roads. **Winchester City**: The Abrams Creek overflowed its banks stranding cars and flooding homes and trailer parks. 3 businesses were damaged from runoff. 200 homes were pumped. Sanitary sewers were overloaded causing backups in basements. Problem areas included Paper Mill Road, Acorn Heights, Whittier Avenue and Amherst Street. **Frederick County**: Many roads leading to the Shenandoah River and across Cedar and Opequon Creeks were closed. Low lying roads along Back Creek, Hogue Creek, Isaac Creek, and Cedar Creek were underwater. Over 200 emergency calls were reported.
October 10, 1972	*(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley, the Winchester Evening Star and the Warren Sentinel)* On Thursday, October 5th through Saturday, October 7th a severe storm system entered Virginia producing 2 inches of rain in Clarke County, 7.5 to 10 inches in Page County, 1.65 inches in Warren County, and 7.65 inches at the Shenandoah National Park. The Shenandoah River crested at 27.5 feet above flood stage in Clarke County, 31 feet at Shenandoah Farms, 28.75 feet in Warren County, 21 feet in Page County, 25.55 feet at Riverton, and 21 feet above flood stage at Luray. **Clarke County**, The Shenandoah Farms area was damaged. 5 houses and 3 mobile homes were inundated with water. Monastery Road off Route 7, Castleman's Ferry Bridge, Route 638 and Route 606 were flooded. Parts of Berry's Ferry Road were washed away. Businesses were evacuated. **Shenandoah County**: Flood damage occurred in New Market, Timberville, and VA Route 953. Cabins along the Shenandoah River were flooded. High waters caused high livestock losses. Schools were closed for a day. **Page County**: 25 homes, 15-20 trailer and recreation homes, farm crops, livestock, and fences were severely damaged, in addition to heavy washing of roads and bridges throughout the county. 1000 homes had minor water damage. Hardest hit areas were in the Naked Creek section on southern part of county, Pine Grove, Mill Creek and Stony Man-Ida sections near Stanley and areas along Hawksbill Creek from Luray to Stanley. In Luray, 5 homes had water enter lower floors. Across the county several roads and bridges were closed. The Hawksbill Creek covered Linden Avenue Bridge in South Luray. The Dyche and Linden Avenue Bridges were underwater and impassable. Mudslides blocked US 211 east of Luray and on US 340 on north and south entrances to Stanley. Homes along Hollow Run were evacuated. Two separate rescues of rafters occurred along the Shenandoah River. The parking lot at Potomac Edison was flooded and water damaged sewage treatment plants at Shenandoah. Water at the Shenandoah Shores community was contaminated. Power and telephone services were briefly disrupted. County damages to farm buildings, equipment, livestock, fences and crops estimated at $120,000 Cont.

Table C-3. Flood Hazard History	
Date	**Damages**
November 9, 1985	*(Source: The Clarke Courier, The Page News and Courier, The Warren Sentinel and The Shenandoah Valley-Herald)* From Thursday, October 31st through Monday, November 4th, Hurricane Juan entered Virginia producing 5 inches in Strasburg and 6.23 in Front Royal. The Shenandoah River crested at 34.4 feet in Clarke County, 35.4 feet near Front Royal, 34.4 ft on the South Fork, 27 feet on the North Fork and 40 feet at Riverton. For this event there were two crests, one that flooded Luray and another that flooded Shenandoah County. **Clarke County**: 40 homes and weekend cabins were damaged. Buildings between Routes 7 and 50 and at Shenandoah Farms were ruined. Recreational facilities at Watermelon Park and River Park were washed away. There was significant damage on Routes 603 and 621. Over 1,000 residents had power outages. The water system was contaminated. Farmers in low lying areas lost crops, fences, livestock and farm equipment estimated at $121,000. County damages estimate: $850,000. **Page County**: This event rivaled the flood of 1870. Several homes, dozens of trailers, and automobiles were damaged along the Shenandoah River's South Fork, Naked Creek, Hawksbill Creek, and other areas. Naked Creek was out of it banks onto the highway. Flooding occurred in Luray, Stanley, Shenandoah, and surrounding areas. The VA Route 611 bridge over Hawksbill Creek fell into river and the VA Route 626 bridge was damaged. North of Luray residents were evacuated by helicopter. 40 miles of fences were destroyed or damaged. Crops were damaged. Power and telephone outages occurred throughout the county. In Luray, some residents were without water. 140 Page County residents registered for flood relief. County damage estimate: $2.4 million, with $1.8 million in private property damage and $540,000 in public property. Damages of state routes in the county: $445,000-$500,000. **Shenandoah County**: This event swept away homes, trailers, vehicles and washed away roads and bridges. There were 10 injuries and one fatality. Houses by Narrow Passage were flooded. Water covered roads near Mt. Jackson. US 11 between New Market and Mt Jackson was closed and US 33 near Elkton was blocked. In Strasburg, 20-30 boats and dock were lost, one home swept away and 6 partially flooded. Roads in southern end of the county suffered most damage. Schools were closed. The majority of losses were from crop damage, fences downed, topsoil destroyed, and farms destroyed. County damage estimate: $2.6 million. Agricultural damages: $274,000 in crop destruction and $68,000 in livestock, fences, damaged farms.

Table C-3. Flood Hazard History	
Date	**Damages**
November 9, 1985	*Cont.* **Warren County**: This event caused damage to homes, farms, businesses, mobile homes, recreational camps, utilities and public property including highways and streets. County schools were closed. Two bridges, one at Bentonville and the other at Howellsville were underwater. 10 county roads and 55 other roads were closed. Residents were evacuated. 25 homes were swept away or moved from foundations. At North Fork, many travel trailers were damaged; one floated away. 10-12 mobile homes at Riverton washed away. There were nominal power and telephone outages. The local Red Cross helped 150 Warren County families and the Salvation army helped 8,000 people. County damage estimate: $6.2 million.
April 19, 1992	*(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley Herald and The Warren Sentinel)* On April 21, a severe storm system entered Virginia producing flash flooding from heavy rains. In a 6 hour period 4.37 inches of rain fell in Clarke, more than 5 inches in southern Fort Valley, 2.5 to 4 inches in the Shenandoah Valley and 4.26 inches near Stanley to nearly 6 inches in Luray. The Shenandoah River crested at 17 feet in Warren County and at 16.3 feet at the White House monitoring station west of Luray. **Clarke County**: This event flooded basements, submerged cars, downed fences, and closed roads along the Shenandoah River. VA Routes 608, 621 and 638 were covered with water. Estimated damages for county: $103,000. **Page County**: Page County suffered heavy property damage, one fatality and one injury. Most of the damages were at Dovel, Jollett and Weaver Hollows where bridges and roads were washed out. 25% of Dovel Hollow was without power. 13 residents were evacuated. Water flooded wastewater treatment plants in Stanley and Shenandoah. Basements along West Main in Luray were inundated. US 340 was briefly closed and the Hawksbill Creek covered the US 211 bridge near Luray and 200 yards of road. The George Washington National Forest had $500,000 in damages. County estimated damages: $200,000 with $90,000 in private property and $165,000 in county roadways. **Warren County**: Public and private roads had the most damage from the overflowing Shenandoah River. Flood waters closed various roads and roads leading into some of the largest river area subdivisions. A mudslide occurred on a secondary road. 60 residents of a subdivision were evacuated. School was closed 2 days. County estimated damages: $315,000 with $215,000 from road damages and $100,000 from damages to homes and businesses.

Table C-3. Flood Hazard History	
Date	**Damages**
January 27, 1996	*(Source: The Page News and Courier, The Clarke Courier, The Shenandoah Valley-Herald and The Warren Sentinel)* On January 27th along with above freezing temperatures, 1.5 to 2 inches of rain fell in the region causing one of the worst flooding events in years. The Shenandoah River crested at 21 feet in Page County, 24.9 feet in Clarke County, 25 feet in Warren County, 27.83 feet in Shenandoah County **Page County**: This event produced the worst flooding in over 10 years. Melting snow and rainfall turned creeks into rivers. At one point Page County was under a high wind warning, flash flood warning, and winter weather advisory. 38 secondary roads were closed, closing all county schools. Flooded streets in Luray included Ninth Ave, Virginia Avenue, Third Street, Linden Avenue and First Street. Portions of US 340 were closed and the VA 677 bridge in Dry Run area of Luray was heavily damaged. Water from Hawksbill Creek overflowed into Mechanic Street. Raw sewage overflowed into several homes on Reservoir Avenue in Luray. Footbridges at Lake Arrowhead were washed out. Residents were evacuated in Weaver Hollow near the Page Rockingham County border. Sections of the Skyline Lakes dam were eroded **Clarke County**: Damage here was widespread. Many people outside of flood prone areas had water in their basements. One home was condemned and 58 homes were damaged, mostly with flooded basements. Recreation facilities in Watermelon Park were destroyed. Berryville's water filtration and sewage treatment plants were damaged. 21 roads in the county were submerged. Historic Burwell-Morgan mill in Millwood had $10,000 in damages. County damage estimate: $735,000 to homes, farming operations and businesses. Berryville estimated damages: $70,000. **Warren County**: Melting snow plus rainfall carried debris, knocked down trees and electric poles, closed schools, and flooded homes and businesses. In Front Royal, a water line break drained 3 million gallons, flooding several roads, e.g. Commerce Ave. and Royal Ave. 200 Front Royal residents called about flooded basements and sewage backups. Flooding occurred along Happy Creek. Hardest-hit areas of the county were below where the North and South Forks of Shenandoah River converge. Subdivisions affected included Shenandoah Farms, Benny's Beach, Shenandoah River Estates, and Shenandoah Shores. 30-40 houses and structures were underwater. 7 families were evacuated. 125 Warren County residents applied for aid with FEMA. **Shenandoah County**: Rain and melting snow damaged roads and bridges, and washed out propane and fuel oil tanks from their places besides homes, in storage bins and in basements. Families were rescued from areas around Mill Creek, Stoney Creek, Edinburg and Mt. Jackson. Mt. Jackson had no drinking water. 110 county homes and Historic Edinburg Mill were severely damaged. Waters took 6 trailers from the Stoney Creek Campground in Edinburg. Large outbuildings and farm equipment were washed away. In Shenandoah County 122 roads and bridges were covered with water. Roads to Bayse were closed. Small bridge approaches were washed away and 5 swinging/footbridges were damaged. A Sinkhole occurred near Edinburg. Schools were out 8 days. 165 registered for help with FEMA. County agricultural damage was estimated at $4.1 million from washed out roads, destroyed fences, crop loss, top soil removed, farm equipment damaged. Road damages were estimate at $500,000 to $3.4 million.

Table C-3. Flood Hazard History	
Date	**Damages**
September 6, 1996	*(Source: The Clarke Courier, The Page News and Courier and The Shenandoah Valley Herald)* On the evening of September 5th through September 6th, Hurricane Fran entered Virginia with heavy winds gusting at 30 mph, producing 10.28 inches of rain at Hogback Mt, 15 inches in Big Meadows on Skyline Drive, 4.5 inches in Luray, 8 inches in Browntown, 3.91 inches in Limeton and 7.12 inches in Strasburg. The Shenandoah River crested at 28 feet in Clarke County under Route 50, 26.82 in Millville, 38.26 feet in Strasburg, and 32.57 feet in Front Royal. **Clarke County**: Apples, fruit trees, corn, various vegetables, fences, farm lanes and roads were damaged. All roads along the Shenandoah River and its tributaries were closed. Damaged roads included Routes 7, 50, 603, 621, 622, 655, 660 and a sinkhole on Route 672. The Shenandoah River flooded Route 638, dividing the Shenandoah Farms subdivision in half. 300 residents lost power and several people were evacuated. 3 homes by White Horse Rock had heavy flood damage. According to FEMA, 39 primary homes and 12 secondary homes were damaged. Watermelon Park wiped out with $100,000 in damages. County damage estimates: $1.2 million in agricultural damage, $894, 000 in property damage. **Warren County**: Red Cross estimated 250 homes were damaged as high winds and floodwaters tossed trees onto houses and cars, submerged homes, and carried debris down swollen creeks and the Shenandoah River. Power was out to 80% of county residents for a few days. Water service was disrupted. Areas of the county hardest hit were Browntown, Bentonville, South Warren, Shenandoah River Estates, Benny's Beach, Apple Mountain, Blue Mountain, and Shenandoah Shores. Half of the Gooney Creek Campground was coveredin water. Between 40-50 people were in shelters or local motels. County damage estimate: $46.1 million in property and agricultural damages. **Page County**: Agricultural losses to poultry, cattle and crop farmers were major. In Shenandoah National Park, 524 trees fell and 3,921 feet of road shoulder were damaged. Park damage was estimated at $1 million. Almost every road in Page County was closed during this event. Virginia Routes 609, 624, 689, 654, 704, 759, and US 340 were damaged. Two low lying bridges in Luray and the VA 689 bridge over Hawksbill Creek were damaged. Thousands were without power and water. Electricity was out for the whole region except portions of Luray and Stanley. Water, telephone, and cable service was disrupted. Schools were closed and mail service was disrupted. Especially hard hit areas were Naked Creek and Crooked Run areas, and the Jollet, Weaver, and Steam Hollows. In Jollet Hollow, 20 homes were wiped out and emergency food was provided to 100 families in the 3 hollows. In Luray, an 8 inch water main that crosses the Hawksbill at the Main Street bridge washed out. This water maine supplied one-half of the residents in Luray. Other damage included parking lots, the Main St bridge, sewer lines/manholes, and businesses along Main Street. Waters flooded Main Street in Luray and ripped apart a barn. A house was moved by waters to the Luray High School football field. Areas in Luray with the most damage included Dry Run, Marye Lane, First Street, Hudson Subdivision, Furnace Road, and North Broad Street. 100 residents in Luray, 48 in Stanley, and 12 in Shenandoah sought shelter. Red Cross estimated 78 homes were destroyed, 117 had major damage, and 439 had damage of some kind. FEMA had 745 applications and estimated $8.1 million in damages to Page County. Other damage estimates ranged from $30 million to $18.5 million. Agricultural damage estimates: $2.6 million, includes damage to crop, livestock, buildings, and fences. Luray damages estimates: $850,000 to town property. Stanley damage estimates: $106,000 to water lines, roads and recreational facilities. **Shenandoah County**: Flooding closed roads and swept away six houses in Deer Rapids and Black Bear Crossing. Waters flooded basements and knocked down trees. All four footbridges across the Shenandoah River were destroyed. US Route 11 was blocked and the bridge at Burnshire Dam in

Table C-3. Flood Hazard History	
Date	**Damages**
	Woodstock was submerged. Power was disrupted, especially at the southern end of the county. 165 homes, a park in Strasburg, numerous roads, and bridges were damaged by this event. The Strasburg water plant had $150,000 of damages and required residents to boil their water. Telephone service was disrupted for 200 residents. 85 homeowners were helped by the Red Cross. In Mt. Jackson, 12 trailers were damaged and 23 residents were evacuated. Homes were moved from foundations in Columbia Furnace. FEMA funds were distributed to 28 families. Agricultural damages: $7.2 million, with damages to corn, soybean and hay crops, fences, and livestock. Road damage estimate: $1.4 million. County damage estimate: $30 million.
August 29, 2006	Virginia Severe Storms and Flooding, Including Severe Storms and Flooding Associated with Tropical Depression Ernesto event August 29, 2006 to September 7, 2006; Major Disaster Declaration declared on September 22, 2006 (DR-1661).
December 9, 2009	On November 20, 2009, Governor Timothy M. Kaine requested a major disaster declaration due to severe weather caused by the remnants of Tropical Depression Ida and a coastal nor'easter beginning on November 11, 2009, and continuing. The Governor requested a declaration for Public Assistance for five counties and seven independent cities. The Governor also requested Hazard Mitigation statewide. During the period of November 16-20, 2009, joint Federal, Commonwealth, and local Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the Commonwealth and the affected local governments, and that Federal assistance is necessary.

Table C-4. Drought Hazard History	
Date	**Damages**
September 1995	Dry weather, combined with periods of excessive heat, caused some damage to several crops and limited the production of healthy livestock during a month-long period that extended through mid-September. The dry weather began after the soaking rains associated with the remains of Hurricane Erin (August 6) moved away. The drought conditions began in earnest over the following three weeks, as dry weather combined with a period of excessive heat (August 13 through 18) to wither crops. Across the region, monthly precipitation averaged one to two inches, with virtually all of it falling before August 7th. The drought continued into mid-September, when it was alleviated somewhat by steady rains late on the 16th and early on the 17th. However, mean temperatures were much lower in September, ironically due to drier air masses, which allowed temperatures to plummet into the 50s on several mornings.
July 1997	A very dry month, containing one 7 day heat wave, exacerbated drought-like conditions across much of the fertile farmland of northern Virginia. The weather in July proved to be the death knell for much of the crop yields, including corn, hay, alfalfa, and soybeans. Clarke Co (VAZ031) alone reported $2 million in crop damage. Other counties in the northern Virginia piedmont reported damage via local farms; dollar estimates were similar to those in Clarke Co, though no formal declarations of federal emergency were received from them.
August 1998 - December1998	Persistent high pressure brought unusually dry weather during the entire month for much of northern and central Virginia. The lack of rainfall substantially reduced crop yields and contributed to increasingly dry timber and brush. The U.S. Forest Service reported the George Washington and Jefferson National Forests were twice as dry as normal, and five fires broke out in these parks during the first week of the month. One of these fires burned a small portion of land near Schothorn Gap in Page Co. In addition to the fire threat, reservoirs continued to dry out. Other monthly rainfall totals from affected counties included 1.5 inches in Page, 0.7 in Warren, and 0.4 in Shenandoah, Winchester reported only 0.3 inches during November. Warren County asked to be declared an agricultural disaster area during November, citing 107 farmers with 60-69% fall production losses and 100 farmers with losses between 40-60%. The hardest hit fall crops were barley, corn, hay, soybeans, tobacco, and wheat. Over 2,000 acres burned in the George Washington and Thomas Jefferson National Forests in Augusta County. December monthly precipitation totals from counties included 0.8 inches in Frederick, 1.2 inches in Clarke, 1.4 inches in Orange and Warren, 1.5 inches in Shenandoah. The Governor declared a state of emergency across Virginia on December 1st due to the dry weather and resulting extreme fire danger. An open burning ban continued across Virginia through December 10th.
May 1999 - September1999	High pressure was the dominant weather feature across Northern Virginia during the month. This weather pattern directed rain producing low pressure systems north of the region and continued the climatological drought that has gripped the area since last summer. By the last week of May the Palmer Drought Index, a measure of long term drought conditions, indicated Northern Virginia was in a moderate drought. Rainfall totals included Frederick County at 1.5 inches, Shenandoah County at 2.9 inches, and Warren County at 1.4 inches. Conditions on the Shenandoah and

Table C-4. Drought Hazard History	
Date	**Damages**
	Rappahannock River were also extremely dry. Some stations in these two watersheds reported stream flow at or below the 90th percentile exceedence, which rivaled minimum daily mean flow values of the drought of 1980 through 1982. Some farmers had to reduce their herd sizes in order to stretch hay and water supplies. In addition to agricultural lands, forests and rural vegetation was also dangerously dry. In Page County alone, fifteen brush fires were reported in May near Stanley, including one that burned 100 acres. Another fire in Shenandoah National Park burned around 400 acres and closed a 40 mile stretch of Skyline Drive for several days during the first week of the month. Rainfall from two land falling hurricanes made a tremendous impact on the drought that plagued the region since the summer of 1998. Rainfall totals included Clarke County at 13.0 inches, Page County at 12.8 inches, Warren County at 12.5 inches, and Shenandoah County at 9.1 inches. In Shenandoah County, 30 ponds that went dry during the past 12 months were rejuvenated by the 8th. The South Fork of the Shenandoah River in Front Royal finally rose to a sufficient level to allow water to rush over the dam, following a several month absence.

Table C-5. Hurricane & High Wind Hazard History	
Date	**Damages**
July 15, 1951	*(Source: Shenandoah Herald, The Shenandoah Valley, The Warren Sentinel and The Winchester Evening Star)* Sunday evening July 15th a severe storm with high winds, hail and thunder entered the region and swept over parts of Warren, Shenandoah and Frederick Counties producing 5 inches of rain in the Town of Timberville and 2 inches in the Town of Woodstock. This event damaged southern and western parts of Woodstock and produced the worst flooding in years. Basements and cellars were flooded. Businesses had water damage and a barn was destroyed by fire from lightning. Trees fell and there was damage to orchards and crops. The Virginia Electric and Power Company had 10 inches of water. In Timberville, the rain washed fields, gardens and roads. In Forestville, high waters covered bridges and roads and washed away flood gates, gardens, cut wheat and trees. In the White Hall section near Winchester this event ripped roofs from buildings, twisted houses on their foundations, knocked down telephone lines and virtually destroyed farm crops in a two-mile area. Lighting caused building fires in Front Royal. This event affected the following towns: White Hall, Timberville, Front Royal, Forestville, Quicksburg, Conicsville and the Fort Valley section of Shenandoah east of Strasburg.

Table C-5. Hurricane & High Wind Hazard History	
Date	**Damages**
October 15, 1954	*(Source: The Clarke Courier, Page News and Courier, Shenandoah Valley, The Warren Sentinel and the Winchester Evening Star)* On October 15th Hurricane Hazel entered the region producing strong winds with gusts up to 40 mph and 9 inches of rain at Shenandoah National Park, 11.20 inches at Big Meadows and 4.05 inches in Winchester. High waters made roads impassible for a time. Winchester City: 10-50% of the apple crops in Winchester were damaged. Clarke County: The Shenandoah River rose over the 6 ft marker at Bixler's Ferry Bridge, 12 to 15 feet higher than normal by Berryville. In Berryville, water flooded Main and Church Streets Approximately 15% of the apple crop reported damaged. Livestock (poultry) was also reported as a loss. Shenandoah County: Damage to apple orchards and livestock was reported. Frederick County: Approximately 15% of the apple crop reported damaged. Also reported was livestock loss, mostly poultry. Page County: minor and some major damage were reported. This storm caused several creeks (i.e., Hawksbill and Dry Run) to overflow, uprooting trees, knocking over fences, scouring roads and washing out parts of bridges. The Luray Sewage Treatment Plant had $1,000 in damages from the overflowing Hawksbill Creek, which also covered US 340 north and south of Luray and carried debris. Many county roads were impassible from high waters and submerged cars. Fallen trees damaged power wires. Stanardsville had major wind damage, with fences, chimneys, antennas, and trees down with debris along the highways. Warren County: this storm event produced losses in livestock, mostly poultry.

Table C-5. Hurricane & High Wind Hazard History	
Date	**Damages**
August 12, 1955	*(Source: The Clarke Courier, The Page News and Courier and The Winchester Evening Star)* From Thursday evening, August 11th to Saturday, August 13th, Hurricane Connie entered Virginia producing minor winds up to 30 mph and rains of 4.71 inches in Clarke County, 3.57 inches at Shenandoah National Park, 6.37 inches at Big Meadows and 6.42 inches in Winchester. The Shenandoah River rose 6 feet above its normal level. Clarke County: Damage from this event was fairly light. Corn, apples, peaches and trees were knocked down. Power and telephone service was disrupted. Electricity to Berryville was out for several hours. Fields, secondary roads and roads along the Shenandoah River were flooded. Page County: Some mountain streams reached flood stage. Rocky Branch washed out sections of roadway. Trees, crops, power lines and antennas were knocked down. There was some livestock loss. Winchester City: This event knocked down trees, blocking roads and causing some power and telephone outages. There was minor crop damage. Two injured and an automobile overturned.

Table C-5. Hurricane & High Wind Hazard History	
Date	**Damages**
August 19, 1955	*(Source: The Clarke Courier, The Page News and Courier, The Winchester Evening Star and The Warren Sentinel)* On Wednesday evening, Hurricane Diane entered Virginia producing minor winds up to 40 mph and 2.98 inches of rain in Clarke County, 10.33 inches at the Shenandoah National Park and 11.48 inches at Big Meadows on the Skyline Drive. The Shenandoah River crested at 29 feet in Clarke County, 29 feet at the Northern & Western Bridge in Warren County, 17 feet by Luray, and 19.9 feet by Berry's Ferry on Route 50. Winchester City: Winchester was cut off to west and south as main highways were underwater. Frederick County: Basements in Middletown were flooded. US Route 11, Route 12, Route 522, and Route 50 were closed. Shenandoah County: The Naked Creek caused significant damage to Verbena. One person drowned in the Shenandoah River near Strasburg. In Woodstock, a break in waterlines compromised the water system. Serious basement flooding occurred at Woodland, Opequon and Berryville Avenue in Woodstock. Clarke County: Since the ground was saturated from Hurricane Connie, waters flooded low lying pastures, fields and river roads. Fences were torn down and crops of corn, beans, tomatoes, and watermelons were ruined. Watermelon Park was damaged, several cabins were damaged but, with one exception, no houses were flooded. Telephone service was disrupted and the receding river left much debris. Damage was estimated in the thousands of dollars. Warren County: This event flooded some roads, produced minor crop damage and minor power outages. Main damage was from sewage overflow into basements. Hard hit were the Front Royal Country Club and the Guilford Electrical Contractors property near Passage Creek. Several homes were flooded in Front Royal and Riverton areas.
August 19, 1955	*Cont.* Page County: 25 residents left their homes along the Hawksbill Creek. Property, livestock and highways had damage. Secondary highways were hard hit. Damaged areas cited included Shenk and Beahm Hollows by Rocky Branch, east of Luray in the Dry Run watershed and in the Ida section. Highway damage was estimated at $50,000, not including replacing the Naked Creek bridge. Livestock damage was estimated at $100,000. County damage estimate: $150,000.

Table C-5. Hurricane & High Wind Hazard History	
Date	**Damages**
May 23, 1959	*(Source: The Clarke Courier and The Winchester Evening Star)* On Saturday afternoon, May 23rd, a severe storm system entered the region producing minor rain but strong winds. This event was the second storm within a week and produced 2-3 inches of rain in northern Frederick County and 0.21 inches in Clarke County. This storm came from the northwest and swept into Clarke County, passing between Winchester and Martinsburg, WV with the worst in Stephenson, VA. Clarke County: This event blew off the roofs of both a house and a barn and caused damages to public utilities, trees, chimneys, and antennas. Telephone service for 200 residents was disrupted and a traffic light was out. Frederick County: Power and telephone services were interrupted. Lightning struck a barn at Longwood, north of Millwood. Hail smashed windows, damaged orchards and knocked down trees. Roads flooded included Route 671, Route 11, and Route 664. Noted areas of damage: White Hall, Stephenson and Burnt Factory.
October 1, 1959	*(Source: The Clarke Courier, Winchester Evening Star and Warren Sentinel)* On October 1, a downgraded Hurricane Gracie entered the region producing 2.03 inches of rain in Clarke County, 2.29 inches in Winchester, 2.05 in Berryville and 0.56 inches in Warren County. Winchester City: This storm event produced no serious damage, however roads were temporary covered. There were minor power outages and 200 telephone lines were knocked out. No other information was provided on this event.

Table C-5. Hurricane & High Wind Hazard History	
Date	**Damages**
June 23, 1972	*(Source: The Clarke Courier, The Page News and Courier, The Shenandoah Valley, The Warren Sentinel and The Winchester Evening Star)* On June 20th through June 22nd, Hurricane Agnes entered Virginia producing 6.07 inches of rain in Clarke County, 8.15 inches at the Shenandoah National Park, 13.35 inches at Big Meadows atop the Blue Ridge, 6.55 inches in Front Royal, and 8.09 inches in Winchester. Clarke County: Hurricane Agnes flooded lowlands, including summer retreats at Shenandoah Farms and The Shenandoah Retreat. 50 families from Shenandoah Farms were evacuated. At this location 13 structures were destroyed. Areas with damages included White Haven, Bradfield Subdivision, Riverside Rendezvous and Watermelon Park. Many cellars were flooded. 11 roads were closed. Two were trapped on an island in Passage Creek. The receding river left much silt and debris. Losses in the county were estimated to be in the thousands of dollars. The Shenandoah River crested at 21.5 feet. Page County: This hurricane produced the worse flood in 30 years causing heavy damages to buildings, fences, roads, bridges, culverts, farmlands and crops near the Shenandoah River, the Hawksbill Creek and in low-lying areas. More than 30% of crops were damaged. Several permanent homes, vacation homes, trailers and poultry houses were damaged. Campgrounds and summer homes along the Shenandoah River were nearly covered. Residents along the Shenandoah River, Hawksbill Creek and other streams were evacuated in addition to residents of the Brookside Subdivision in East Luray. More severe damage was done to small bridges, roads, and culverts in part of the county. The Hawksbill Creek severely damaged the Linden Avenue and Dyche Bridges in Luray and carried a truck downstream. Roads in Luray and Shenk Hollow were washed out. Shenandoah's water treatment plant was out of service. Most heavily damaged section was the Pine Grove area near Stanley. There was one fatality. Luray damage estimate: $25,000. County damage estimate: $100,000, in farm and crop damage. Frederick County: Many roads leading to the Shenandoah River and across Cedar and Opequon Creeks were closed. Low lying roads along Back Creek, Hogue Creek, Isaac Creek, and Cedar Creek were underwater. 200 emergency calls were reported.
June 23, 1972	*Cont.* Shenandoah County: This event flooded low farm lands and blocked major and secondary roads. There was some agricultural and livestock damages. Over 78 highway locations had damage from stream crossings and with debris and mudslides at several locations. Ditches were washed out and debris/silt/stone was deposited on roads. There was a large mudslide in the Zepp area of western Shenandoah County. Cedar Creek damaged a wayside and spread debris over several roads. Meem's Bottom road, Redbanks Bridge and U.S. 11 were covered. County damage estimate: $106,000 with damage mostly on secondary roads.

Table C-5. Hurricane & High Wind Hazard History	
Date	**Damages**
	Warren County: Areas adjacent to either fork of the Shenandoah River were underwater for days. Happy Creek, South Fork, and Passage Creek overflowed. Riverton was flooded. This event completely destroyed 21 homes, seriously damaged 150 homes, and left 50 homes with minor damage. 14 homes in Shenandoah Farms, 4-5 homes in Mandalay, 2 homes in Shenandoah Shores, 2 homes and 5 trailers at Avalon Shores in Riverton were lost to flooding. Bridges at Bentonville and Morgan's Ford were underwater. Telephone service was out. The biggest problem was backed up sewage. People got typhoid shots. There was no drinking water. County damage estimate: $1.5 million. The Shenandoah River rose 29.56 feet in Warren County, Winchester City: The Abrams Creek overflowed its banks stranding cars and flooding homes and trailer parks. 3 businesses were damaged from runoff. 200 homes were pumped. Sanitary sewers were overloaded causing backups in basements. Problem areas included Paper Mill Road, Acorn Heights, Whittier Avenue and Amherst Street.
November 9, 1985	*(Source: The Clarke Courier, The Page News and Courier, The Warren Sentinel and The Shenandoah Valley-Herald)* From Thursday, October 31st through Monday, November 4th, Hurricane Juan entered Virginia producing 5 inches in Strasburg and 6.23 in Front Royal. The Shenandoah River crested at 34.4 feet in Clarke County, 35.4 feet near Front Royal, 34.4 ft on the South Fork, 27 feet on the North Fork and 40 feet at Riverton. For this event there were two crests, one that flooded Luray and another that flooded Shenandoah County. Clarke County: 40 homes and weekend cabins were damaged. Buildings between Routes 7 and 50 and at Shenandoah Farms were ruined. Recreational facilities at Watermelon Park and River Park were washed away. There was significant damage on Routes 603 and 621. Over 1,000 residents had power outages. The water system was contaminated. Farmers in low lying areas lost crops, fences, livestock and farm equipment estimated at $121,000. County damages estimate: $850,000. Page County: This event rivaled the flood of 1870. Several homes, dozens of trailers, and automobiles were damaged along the Shenandoah River's South Fork, Naked Creek, Hawksbill Creek, and other areas. Naked Creek was out of it banks onto the highway. Flooding occurred in Luray, Stanley, Shenandoah, and surrounding areas. The VA Route 611 bridge over Hawksbill Creek fell into river and the VA Route 626 bridge was damaged. North of Luray residents were evacuated by helicopter. 40 miles of fences were destroyed or damaged. Crops were damaged. Power and telephone outages occurred throughout the county. In Luray, some residents were without water. 140 Page County residents registered for flood relief. County damage estimate: $2.4 million, with $1.8 million in private property damage and $540,000 in public property. Damages of state routes in the county: $445,000-$500,000. Warren County: This event caused damage to homes, farms, businesses, mobile homes, recreational camps, utilities and public property including highways and streets. County schools were closed. Two bridges, one at Bentonville and the other at Howellsville were underwater. 10 county roads and 55 other roads were closed. Residents were evacuated. 25 homes were

Table C-5. Hurricane & High Wind Hazard History	
Date	**Damages**
	swept away or moved from foundations. At North Fork, many travel trailers were damaged; one floated away. 10-12 mobile homes at Riverton washed away. There were nominal power and telephone outages. The local Red Cross helped 150 Warren County families and the Salvation army helped 8,000 people. County damage estimate: $6.2 million. Shenandoah County: This event swept away homes, trailers, vehicles and washed away roads and bridges. There were 10 injuries and one fatality. Houses by Narrow Passage were flooded. Water covered roads near Mt. Jackson. US 11 between New Market and Mt Jackson was closed and US 33 near Elkton was blocked. In Strasburg, 20-30 boats and dock were lost, one home swept away and 6 partially flooded. Roads in southern end of the county suffered most damage. Schools were closed. The majority of losses were from crop damage, fences downed, topsoil destroyed, and farms destroyed. County damage estimate: $2.6 million. Agricultural damages: $274,000 in crop destruction and $68,000 in livestock, fences, damaged farms.
April 4, 1995	In Winchester City, high sustained winds estimated at 40 mph with gusts to 50 mph blew a large tree onto the roofs of two homes, causing minor structural damage to them. A gas meter at one of the homes was damaged, starting a small leak. The high winds, however, reduced the concentration of gas in any one area, and no explosions occurred.
June 10, 1995	In Winchester City, a construction trailer was damaged by thunderstorm winds. Several maple trees were blown down, and eight to 10 telephone poles were found leaning in one direction due to the high winds. Panels were blown off a greenhouse along state route 37 near federal Highway 11. Fallen branches broke several automobile's windshields. Trees were also reported to be blocking local Routes 634 and 642, and the on-ramp to Interstate Highway 81.
July 6, 1995	In Page County, widespread tree damage in the central and northern portions of the county. A metal shed was crushed and blown into the road. A barn north of Luray was destroyed by winds killing two cattle and heavily damaging farm vehicles and equipment. Property damage at the farm was estimated to be around $200 thousand.
October 5, 1995	Sustained winds of 40 mph, with gusts in excess of 60 mph, blew down several trees at higher elevations (mainly above 2,000 feet) in the Shenandoah Valley and along the Allegheny Plateau. The winds were associated with the remains of Hurricane Opal, which was accelerating through the lower Ohio Valley during the afternoon of the 5th. In the southern portion of the City of Winchester , an estimated 2,000 customers were without power after a feeder lockout (7200 Volt) was knocked out. The National Park Service reported dozens of trees blown down along Skyline Drive in Page and Warren Counties..
May 4, 1996	A microburst produced wind gusts estimated at 70 mph, which blew down numerous tents at a Boy Scout "camporee" in the New Market Battlefield Park, Shenandoah County. Fortunately, there were no injuries among the 1500 scouts attending the event.
July 14, 1996	A microburst destroyed a 1,300 square-foot barn at a farm. A nearby 800 pound loader was moved 15 to 20 feet by the winds, but was not damaged.

Table C-5. Hurricane & High Wind Hazard History

Date	Damages
September 6, 1996	*(Source: The Clarke Courier, The Page News and Courier and The Shenandoah Valley Herald)* On the evening of September 5th through September 6th, Hurricane Fran entered Virginia with heavy winds gusting at 30 mph, producing 10.28 inches of rain at Hogback Mt, 15 inches in Big Meadows on Skyline Drive, 4.5 inches in Luray, 8 inches in Browntown, 3.91 inches in Limeton and 7.12 inches in Strasburg. The Shenandoah River crested at 28 feet in Clarke County under Route 50, 26.82 in Millville, 38.26 feet in Strasburg, and 32.57 feet in Front Royal.Gusty winds in excess of 40 mph, combined with soft soil from previous rainfall, caused scattered tree damage across much of the Virginia Piedmont and a small area of the coastal plain. At elevations above 2,000 feet, sustained tropical-storm force winds with gusts as high as 79 mph pummelled the landscape, especially the east-facing slopes of Shenandoah National Forest and the George Washington National Forest. Thousands of mainly light wood trees (pines and maples) were snapped or uprooted. Along Skyline Drive alone, over 500 trees had to be cleared from the roadway before it could be reopened. Numerous trails had trees down; some trails remained closed more than one month after the event. In the central Shenandoah Valley, an area closest to the storm track, widespread scattered tree damage was noted. Clarke County: Apples, fruit trees, corn, various vegetables, fences, farm lanes and roads were damaged. All roads along the Shenandoah River and its tributaries were closed. Damaged roads included Routes 7, 50, 603, 621, 622, 655, 660 and a sinkhole on Route 672. The Shenandoah River flooded Route 638, dividing the Shenandoah Farms subdivision in half. 300 residents lost power and several people were evacuated. 3 homes by White Horse Rock had heavy flood damage. According to FEMA, 39 primary homes and 12 secondary homes were damaged. Watermelon Park wiped out with $100,000 in damages. County damage estimates: $1.2 million in agricultural damage, $894, 000 in property damage. Page County: Agricultural losses to poultry, cattle and crop farmers were major. In Shenandoah National Park, 524 trees fell and 3,921 feet of road shoulder were damaged. Park damage was estimated at $1 million. Almost every road in Page County was closed during this event. Virginia Routes 609, 624, 689, 654, 704, 759, and US 340 were damaged. Two low lying bridges in Luray and the VA 689 bridge over Hawksbill Creek were damaged. Thousands were without power and water. Electricity was out for the whole region except portions of Luray and Stanley. Water, telephone, and cable service was disrupted. Schools were closed and mail service was disrupted. Especially hard hit areas were Naked Creek and Crooked Run areas, and the Jollet, Weaver, and Steam Hollows. In Jollet Hollow, 20 homes were wiped out and emergency food was provided to 100 families in the 3 hollows. In Luray, an 8 inch water main that crosses the Hawksbill at the Main Street bridge washed out. This water main supplied one-half of the residents in Luray. Other damage included parking lots, the Main St bridge, sewer lines/manholes, and businesses along Main Street. Waters flooded Main Street in Luray and ripped apart a barn. A house was moved by waters to the Luray High School football field. Areas in Luray with the most damage included Dry Run, Marye Lane, First Street, Hudson Subdivision, Furnace Road, and North Broad Street. 100 residents in Luray, 48 in Stanley, and 12 in Shenandoah sought shelter. Red Cross estimated 78 homes were destroyed, 117 had major damage, and 439 had damage of some kind. FEMA had 745 applications and estimated $8.1 million in damages to Page County. Other damage estimates ranged from $30 million to $18.5 million. Agricultural damage estimates: $2.6 million, includes damage to crop, livestock, buildings, and fences. Luray damages estimates:

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Date	**Damages**
	$850,000 to town property. Stanley damage estimates: $106,000 to water lines, roads and recreational facilities. Shenandoah County: Flooding closed roads and swept away six houses in Deer Rapids and Black Bear Crossing. Waters flooded basements and knocked down trees. All four footbridges across the Shenandoah River were destroyed. US Route 11 was blocked and the bridge at Burnshire Dam in Woodstock was submerged. Power was disrupted, especially at the southern end of the county. 165 homes, a park in Strasburg, numerous roads, and bridges were damaged by this event. The Strasburg water plant had $150,000 of damages and required residents to boil their water. Telephone service was disrupted for 200 residents. 85 homeowners were helped by the Red Cross. In Mt. Jackson, 12 trailers were damaged and 23 residents were evacuated. Homes were moved from foundations in Columbia Furnace. FEMA funds were distributed to 28 families. Agricultural damages: $7.2 million, with damages to corn, soybean and hay crops, fences, and livestock. Road damage estimate: $1.4 million. County damage estimate: $30 million. Warren County: Red Cross estimated 250 homes were damaged as high winds and floodwaters tossed trees onto houses and cars, submerged homes, and carried debris down swollen creeks and the Shenandoah River. Power was out to 80% of county residents for a few days. Water service was disrupted. Areas of the county hardest hit were Browntown, Bentonville, South Warren, Shenandoah River Estates, Benny's Beach, Apple Mountain, Blue Mountain, and Shenandoah Shores. Half of the Gooney Creek Campground was coveredin water. Between 40-50 people were in shelters or local motels. County damage estimate: $46.1 million in property and agricultural damages
June 18, 1997	A rapidly developing heavy-precipitation supercell produced several instances of severe weather over portions of the northern Shenandoah Valley and Piedmont regions of Virginia during the late afternoon and evening of the 18th. Four small tornadoes were confirmed: one in northern Shenandoah County near the town of Wheatfield, one in extreme southeast Frederick Co in the community of Double Tollgate, a third in Clarke Co near the town of Berryville, and a fourth in Loudoun Co between Mountville and Oatlands. Damage in Wheatfield was confined to a heavily wooded rural area, where 20 trees were snapped or uprooted along a narrow but distinctive path. Winds were estimated to be around 80 mph. It was the first tornado ever reported in the county; perhaps partially due to a NWS survey team locating the damage. The twister lifted along the county line, later seen as a funnel near Stephens City (Frederick Co) before dissipating. The second small tornado touched down east of Klines Corner in southeast Frederick Co. Five trees were downed on one farm, and damage was spotty along a 3-mile path to Double Church Road just southwest of Double Tollgate. A spotter had previously reported a touchdown near this area. Most of the damage was to trees, though some minor roof and fence damage was observed along and near Double Church Road. In Clarke Co, a third tornado touched down just south of Berryville. Minor damage was noted to a roof and shingles at a house; an electric garage door was damaged as well. A circular pattern was noted in the tall grass and in branches that had broken off nearby trees.

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Date	**Damages**
June 26, 1997	A pre-frontal squall line moving into very unstable air produced several instances of straight-line wind damage, including some from in-storm downbursts and others along the gust front. The most intense damage occurred early in the event, in northeast Frederick Co. A strong downburst, containing estimated winds of 80 to 100 mph, produced a swath of damage approximately 1 mile wide and 4 miles long between Welltown and Stephenson. The heaviest structural damage occurred with the onset of the downburst at an industrial park located just north of the intersection of interstate 81, federal highway 11 and state route 37. Damage at the park included one steel-frame building (under construction) which collapsed, and minor damage to several other buildings. The downburst raced into nearby forested areas, where heavy damage was sustained (numerous trees were uprooted or snapped) and some utility poles were felled. Thereafter, four residential homes sustained roof damage, with two declared uninhabitable. One large barn collapsed, as did three large sheds. Two mobile homes shifted off their moorings. A total of 50 structures sustained minor to major damage, including siding, gutters, windows, and roofs. Additional tree damage, including one onto a car, occurred in nearby Stephenson before the downburst dissipated. Other tree damage was reported in Madison and Clarke Cos. Several trees fell in northern Clarke Co along local route 611.
July 28, 1997	A squall line, which originated from an individual thunderstorm in southwest Pennsylvania, produced scattered wind damage across northern Virginia during the late afternoon as it raced across the region. The most impacting damage occurred in Frederick Co, where numerous trees and wires were blown down in the Winchester area. One of those trees became an airborne missile, crashing through an automobile windshield and slightly injuring the 30-year old female driver. In Clarke Co, several trees and large limbs were felled in the Berryville area, including one onto the historic home of George Washington's adopted daughter. Numerous wires were reported down as well.
June 13, 1998	A vigorous upper-level disturbance acted upon increasingly warm and humid air near the surface to produce a squall line of strong to severe thunderstorms which traversed all of northern Virginia during the afternoon. Overall, damage was dominated by numerous downed trees, large limbs, and power lines, though there were scattered occurrences of large hail with the more intense cells. Localized small stream and poor drainage flooding was noted, but true flash flooding did not occur due to the rapid movement of the line. Initial damage occurred across northwestern Virginia, where there were several instances of scattered trees and large limbs down across portions of Clarke, Loudoun, Warren, and Fauquier Cos. There were several citizen and police reports of funnel clouds in the area, but surveys determined that damage was straight-line in nature - either due to embedded microbursts or the gust front. Farther south, hail fell, most between three-quarters and one inch in diameter.
June 15, 1998	The juxtaposition of a northward moving warm front, strong surface low pressure over the midwest, and a fast upper-level jet combined to produce another outbreak of severe weather - this coming two days after a notable episode over much of northern Virginia on the 13th. Once again, damage was highlighted by downed trees, large hail, and several cases of flash flooding. Several side streets were flooded, not only in Woodstock but in nearby Toms Brook as well. As the storms tracked east, there were several reports of hail ranging from 0.75" to 1" in diameter. Additional flash flooding occurred in Warren Co, where a minor mud slide temporarily closed a portion of Browntown Road. Low-lying flooding closed the intersection of River and Harrell Road. Around this time, one thunderstorm cell became dominant as it crossed into Fauquier Co. Soon after, the storm exhibited a bow-echo feature, and accounts of damaging winds increased accordingly.

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Date	Damages
July 30, 1998	An isolated rotating thunderstorm developed along a stationary front over western Frederick Co and moved east, producing some wind damage and a small tornado near and east of Gainesboro. At a residence on Hunting Ridge Road just east of Gainesboro, a brief tornado snapped or uprooted 50 to 60 trees, including pines and oaks. One of the trees smashed a portion of a fence. Moments earlier, in Gainesboro, lightning started two grass fires and struck a home, causing minor damage. Strong winds blew down several power lines as well.
March 3, 1999	Trees and power lines downed A low pressure system moved from West Virginia to Pennsylvania on the evening of the 3rd. This system produced sustained winds of 25 to 40 mph from the afternoon of the 3rd through the morning of the 4th. A cold front associated with the system moved through during the early evening and produced a line of thunderstorms that brought heavy rain, small hail, and wind gusts in excess of 55 mph. In Shenandoah County, downed trees and power lines were reported across the county. 1,375 customers reported power outages. A roof was blown off an outbuilding in Fairview near Woodstock, and the top of an automated teller machine at the Strasburg Shopping Center was also blown off. Frederick County reported substantial damage to a large wall at the Rubbermaid Commercial Products Receiving Warehouse in Winchester. The wind also leveled several trees and signs. 6,000 customers reported power outages. The peak gust at the Winchester Airport was 42 mph. Most locations received an inch or less of snow overnight, however Frederick County received 2 to 5 inches and a location on the Clark and Loudoun County line received 3 inches.
April 23, 1999	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 in a 10 mile wide strip from Winchester in Frederick County to Woodbridge in Prince William County. Winds over 55 MPH also downed trees and power lines in Frederick and Clarke County. Frederick County spotters reported between 1 3/4 to 3 1/2 inch diameter hail. The rubber membrane roof of the War Memorial Building in Winchester was punctured by hail the size of golf balls, allowing heavy rain to fall inside the structure and cause significant water damage. Numerous cars were damaged by hail, averaging $1300 in repairs. Winchester city police reported damage to 15 cruisers, and automobile dealers on Valley Avenue reported damage to over 150 cars. Hundreds of other privately owned vehicles received dents and broken windshields. Property owners also reported damage to roofs, siding, windows, and landscaping from the 10 minute deluge. Northwest of Winchester, strong winds left behind a narrow path of uprooted or snapped trees and minor trim damage to a home. Clarke County was the next location in the path of the storm. Hail of up to 1 3/4 inch in diameter tore leaves from trees, damaged siding and shingles on homes, and dented automobiles. Strong winds also snapped or uprooted between Beacon and the Shenandoah River.
May 12, 1999	One tree uprooted and several trees split in a county park A thunderstorm producing wind over 55 MPH moved across Northern Clarke County. County park officials reported the storm downed a large tree by the recreation office and split several other trees lining the entrance driveway. Also, a staff member who was driving a maintenance truck around the county park during the storm reported gusty winds caused their vehicle to shake.
July 31, 1999	Scattered thunderstorms developed over the Shenandoah Valley. One storm moved across Clarke County and produced winds in excess of 55 MPH, downing trees in White Post. Two trees blocked Route 644. Lightning from another thunderstorm ignited a forest fire west of Woodstock in Shenandoah County on the 31st.
August 13, 1999	An area of thunderstorms that developed across West Virginia moved across Northern Virginia on the 13th through the 14th. The

Table C-5. Hurricane & High Wind Hazard History	
Date	**Damages**
	strongest storms produced wind gusts in excess of 55 MPH, frequent lightning, and heavy downpours. Downed trees were reported across Shenandoah County. Trees were also downed just east of Strasburg in Warren County.
August 14, 1999	Trees downed An area of intense thunderstorms producing damaging winds, frequent lightning, and heavy downpours moved across extreme Northern Virginia between 3:00 PM and 6:00 PM EDT. As the storms moved across Clarke County, straight line winds in excess of 55 MPH demolished a shed on a farm near White Post. The shed's heavy roof was lifted off and set down 50 feet away from the rest of the structure. A tree nearby was also toppled. County officials reported several other trees down across the county, including some across Route 50. In Warren County, strong winds downed several trees in Front Royal around 3:15 PM EDT. As the storms crossed Fauquier County, a wind gust of 60 MPH was measured in Warrenton.
September 7, 1999	Only a few days after Northern Virginia received rains from the remnants of Hurricane Dennis, an area of thunderstorms moved through the area producing damaging winds, large hail, frequent lightning, and very heavy downpours. The storms affected the region. Frederick and Clarke Counties received the heaviest rainfall, and suffered from Significant flash flooding. An observer in Clearbrook reported rain gauges that held 5 inches overflowed during the storm. Another observer in the eastern half of Frederick County received a total of 5.3 inches, with 3.5 inches of the total recorded in 1 hour. One location in Clarke County reported 3.8 inches of rain in 1 hour. A portion of Highway 7 was closed by high water near Berryville. Both Boyce and Berryville reported street flooding. The communities of Greenwood and Stephens City reported several flooded roads and basements. Severe flooding and mudslides blocked roads between Highway 7 and Route 50, and another mudslide affected Route 50. In addition, Route 635, 657, 255, 621, 620, 651, and 761 were all closed for a short period of time due to high water in Clarke County. Shenandoah County also received heavy rain and reported minor flooding. Just south of Strasburg, 1.5 inches fell. County officials reported a low lying bridge on Highway 744 was covered with water in the Deer Rapids area near Massanutten Mountain. A low water bridge at Black Bear Crossing east of Maurertown and at Chapman's Landing south of Woodstock were also flooded and impassable. Several basements and roads were flooded in Strasburg. In addition, winds in excess of 55 MPH downed trees and power lines in several locations. Several trees were downed in the eastern part of Frederick County. Power lines were downed and lightning started several tree fires in the Greenwood area. Trees were downed across Clarke County with a concentration in the Berryville area. .
September 16, 1999	Hurricane Floyd made landfall just east of Cape Fear, North Carolina in the early morning hours of the 16th and moved north-northeast across extreme southeast Virginia to near Ocean City, Maryland by evening on the 16th. Rain bands on the outer edge of the hurricane began to affect northern Virginia on the 15th and continued to cross the area through afternoon on the 16th. The eye of Hurricane Floyd passed east of the Chesapeake Bay on the 16th. Gusty winds of 30 to 50 MPH blew north and east of a line from Spotsylvania County to Frederick County on the 16th. Hundreds of trees were downed from the combination of very heavy rain and strong winds. A total of 2 to 5 inches of rain fell in this area and 16,000 power outages were reported. In Winchester, a home was damaged by a fallen tree and a few customers lost power.

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Date	Damages
September 29, 1999	An area of intense showers moved across Northern Virginia on the 29th through the 30th, producing winds in excess of 55 MPH and very heavy downpours. Flash flooding was reported in several counties, and high winds knocked numerous trees and power lines down. In Frederick County, winds gusted to 60 MPH at Hayfield. An old convenience store along Route 50 in the Hayfield area had sections of its roof ripped off and thrown into the parking lot. Trees and power lines were downed across the northern half of the county and the city of Winchester, resulting in power outages for 1400 customers. Fallen trees blocked 1 1/2 lanes of Interstate 81 southbound between Route 50 and Route 7. High winds blew a metal canopy off a building along Route 50 east of Winchester and brought trees down across the highway. Winds gusted to 47 MPH at the Winchester Airport. Clarke County reported wind damage and flooding. Trees and power lines were downed countywide blocking 25 roads, including Route 540, 955, and 1513. An acre of trees on Blue Ridge Mountain was flattened. Flash flood waters washed out a culvert on Route 723 and a bridge on Route 604.
January 13, 2000	A vigorous cold front moved across Northern Virginia from west to east midday on the 13th. Winds in excess of 55 MPH reached the surface after the front moved through. Fire fighters across the region were kept very busy by several brush fires that were started by downed power lines and spread quickly because of the gusty winds. In Frederick County, trees and power lines were downed in Stephens City and downed trees blocked Middle Road, Stoney Hill Road, and Morgan's Hill Road. A carport was blown off a home in Berryville. In Winchester, a house lost a portion of its roof and a wind gust of 52 MPH was recorded. In Clarke County, downed trees and power lines blocked Bishop Mead Road, Route 255 near Millwood, and 6 other secondary roads.
May 13, 2000	Temperatures in the mid 80s to lower 90s in combination with humid conditions resulted in several rounds of thunderstorms across Northern and Central Virginia from midday through late evening on the 13th. Several storms produced winds in excess of 55 MPH, large hail, frequent lightning, and very heavy downpours. The tornado moved into the Woodbrook neighborhood where it damaged a few homes and trees then dissipated. Hundreds of trees in the path of this 300 yard wide tornado were downed or snapped. In Page County, several trees and power lines were downed near Luray and Rileyville. One car on Cave Hill Road was hit by a falling tree. A homeowner on Yager Spring Road reported part of a roof peeled back and a downed chimney. Nearly 3,100 county customers lost power and two homes where hit by lightning. Pea to quarter sized hail fell in Luray. A computer in a home in Leaksville was melted by a bolt to lightning. Another home near the Shenandoah River Bridge was destroyed by fire after lightning struck. In Warren County, trees were damaged in Bentonville. In Shenandoah County, quarter to golf ball sized hail fell in New Market.

Table C-5. Hurricane & High Wind Hazard History	
Date	**Damages**
June 15, 2000	Trees were downed onto a house, barn, tent, and several roads. A line of thunderstorms that contained winds in excess of 55 MPH, large hail, heavy rain, and frequent lightning moved across the area during the afternoon and evening of the 15th. In Shenandoah County, trees were downed in New Market and Tom's Brook. The roof of a barn was also peeled back. Rainfall totals included 1.46 inches in Fetzer Gap and 1.34 inches at the Strasburg Reservoir. In Page County, a wind gust of 42 MPH was recorded in Luray. In Frederick County, dime sized hail fell on Route 522 north of Winchester. A tree was downed onto a power line in Winchester. Several structures across the county were hit by lightning. Heavy rain washed out Back Creek Road in the western portion of the county and flooded several streets in Winchester. A total of 2.11 inches fell in Winchester and 1.81 inches fell in Gore. In Warren County, several trees were downed onto roads, power lines, and structures across the county. Communities hardest hit included Shenandoah Farms, Front Royal, and Linden. A house was damaged by a downed tree in Rockland. A camper on Blue Mountain just outside of Front Royal was injured when a tree fell onto his tent. A 160-year-old house, a car, a fence, and a barn were damaged by several felled trees near Cedarville. Power lines were downed on Apple Mountain. Heavy rain flooded streets in Front Royal. Rainfall totals included 1.61 inches in Nineveh, 1.51inches near Strasburg, and 1.31 inches on Hogback Mountain. In Clarke County, trees were downed and pea sized hail fell in Berryville. Power lines were downed across the county. Route 340 north of Berryville was blocked by downed trees.
June 26, 2000	Thunderstorms developed across the area on the afternoon of the 26th. The strongest storms produced winds in excess of 55 MPH, frequent lightning, and heavy rainfall. In Frederick County, a chimney was blown over and tree limbs were downed east of Winchester. Lightning also downed a tree onto a storage building in Winchester where an inch of rain fell in 15 minutes. In Clarke County, several trees were downed onto power lines, cars, and roads from Boyce south and east to the county line. Hardest hit areas included Boyce, Calmes Neck, Millwood, and Waterloo. Several trees were downed onto power lines, cars, and roads in Boyce and Millwood.
July 10, 2000	Thunderstorms that produced winds in excess of 55 MPH, large hail, frequent lightning, and heavy downpours moved across northern Virginia during the afternoon and evening of the 10th. In Shenandoah County, trees and power lines were downed from Edinburg to Woodstock. One felled tree destroyed a stoplight. A lightning strike damaged a school gymnasium in Woodstock. A total of 1.51 inches of rain fell in Zepp. In Page County, trees were downed near the Warren County border. In Warren County, trees were downed onto roads, a roof, and a car in Browntown.
July 14, 2000	A cold front moved across the region during the evening of the 14th. Thunderstorms that developed ahead and along this front produced very heavy rainfall, large hail, and winds in excess of 55 MPH. In Page County, trees were downed north of Luray. A total of 2.11 inches of rain fell at Rocky Branch. In Warren County, rainfall totals included 1.70 inches in Strasburg and 1.61 inches in Nineveh.
July 29, 2000	Scattered thunderstorms that produced heavy rainfall moved across the central Shenandoah Valley during the afternoon of the 29th. In Shenandoah County, high winds damaged several structures and crops. The aluminum roof of a turkey barn was blown off and thrown 300 yards by high winds. Nearby, trees and corn crops were blown over and apples were blown off trees in an orchard. In addition, the roof of a well house was removed an a large white column was torn from the front porch of a house. A total of 1.66 inches of rain fell in New Market. In Page County, 1.74 inches fell at Lewis Mountain Camp.

Table C-5. Hurricane & High Wind Hazard History	
Date	**Damages**
August 9, 2000	A cold front moved across the region on the evening of the 9th. Thunderstorms that developed ahead and along the front produced winds in excess of 55 MPH, hail, frequent lightning, and isolated tornadoes. In Shenandoah County, an F0 tornado briefly touched down on property adjacent to Red Bank Road near Bowman's Crossing. The 15 yard wide twister started by sucking up water on the banks of the North Fork of the Shenandoah River. Next, it moved onshore and traveled north for two tenths of a mile. It downed or snapped five trees and flattened part of a corn field before dissipating. Straight line winds downed trees and power lines near New Market and Mt. Jackson. A wind gust of 42 MPH was recorded in Edinburg and hail fell in New Market. A barn roof and side were blown apart near Hayfield. Dime sized hail fell in Stephenson and Winchester. A tree was downed onto a power line on Amherst Street and lightning started an attic fire in Winchester where a wind gust of 40 MPH was recorded.
December 12, 2000	A vigorous cold front crossed the region on the 12th. As the front passed, northwest winds gusted up to 45 MPH and didn't begin to subside until midday. In Frederick County, numerous power line failures were reported. Downed trees caused power outages in 10 different areas, including Winchester. A wind gust of 46 MPH was recorded at the Winchester Airport. In Warren County, 6 trees were blown down at Massanutten Mountain Drive and High Knob Road. One downed power line sparked a brush fire.
March 21, 2001	A Nor'easter moved from the North Carolina Coast to New England from the 20th to the 22nd. As it passed by the Mid Atlantic region, it dropped heavy precipitation between midnight and mid afternoon on the 21st. Below 2,000 feet, the precipitation fell in the form of rain. Across the Shenandoah Valley and just east of the Blue Ridge Mountains, the storm system dropped between 2 and 5 inches of rain which resulted in flash flooding. Some of the highest regional rainfall totals included 4.44 inches at Big Meadows in Page County, and 4.36 inches at Strasburg Reservoir in Shenandoah County.. Numerous roads and low water crossings were closed by high water in Frederick, Page, Shenandoah, Warren, and Clarke Counties. The gusty winds downed a tree onto a shed near Conicville in Shenandoah County.
May 27, 2001	Two rounds of thunderstorms moved across Northern Virginia on the 27th. The first round crossed the Northern Shenandoah Valley and produced winds in excess of 55 MPH, dangerous lightning, hail, and a tornado. In Shenandoah County, a home in Strasburg was struck by lightning. Marble sized hail was reported in Tom's Brook. Trees and power lines were downed by high wind in Orkney Springs. In Warren County, an F1 tornado touched down around 1 mile southwest of Ashby, just south of Route 639. The tornado moved east-northeast and crossed Route 639 just east of Ashby. Shortly after, it crossed Route 658 just south of White Oak Level and moved into Clarke County at Milldale Road (Route 624). Before exiting the county, the tornado struck three farms just east of Ashby. It tore the tin roof off a barn and threw it 100 yards. A farmhouse suffered a projectile hole and minor damage to trim and a window. The tornado also damaged a silo, several sheds, and small outbuildings. In addition, numerous trees were uprooted and snapped along the tornado's 4 mile long and 100 yard wide path. The tornado remained on the ground for another mile after it crossed into Clarke County at Milldale Road (Route 624), about 3 miles southeast of Stone Bridge. Several trees were downed on the roadway at this location. The tornado traveled to the northeast through woodlands, then dissipated about 5 miles east of Stone Bridge. In addition, a funnel cloud was spotted by a police officer over White Post, north of the storm. The officer followed the storm that produced the funnel cloud from White Post to Berryville and saw the funnel drop down several times, but never touch the ground. The only damage reported from this storm was from

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Date	**Damages**
	large amounts of golf ball sized hail that accumulated up to 6 inches in depth between Double Tollgate and White Post. The large hail damaged an asphalt roof, a flat membrane roof, and light fixtures. It was also responsible for chipping paint off a home and stripping leaves off vegetation.
June 6, 2001	In Page County, a microburst of wind estimated between 60 and 70 MPH damaged several buildings in Jollett Hollow about 5 miles east of Shenandoah. The wind damage began at a small clearing adjacent to Jollett Road (Route 759) just south of Naked Creek Baptist Church. The damage path continued northeast onto private property where part of a roof was blown off a home and a car port was removed from its foundation. Pieces of the structure were thrown east about 100 yards onto the roof of a home. Several trees were uprooted and several outbuildings were destroyed nearby.
June 21, 2001	Thunderstorms that produced damaging winds and very heavy downpours moved across northern Virginia between 7 PM EDT on the 21st through 2 AM EDT on the 22nd. In Shenandoah County, numerous trees were downed in the southern portion of the county, including the community of Conicville. High winds ripped three quarters of a tin roof off a mobile home on Port Republic Road north of Grottoes. The remains of the tin roof were rolled into a ball and thrown 50 feet from the structure. A few trees were downed near the home but neighbors nearby did not report any damage. Heavy downpours flooded portions of Routes 611, 701, 724, 691, 672, 675, 1419, 667, 663, and 600. The Shenandoah River and Stoney Creek overflowed their banks in a few locations. A total of 3.04 inches of rain was reported at Jerome Gap. In Warren County, a wind gust of 53 MPH was recorded on Catlett Mountain Road. Trees were downed in the vicinity and a plane was damaged at the Warren County Airport nearby. In Page County, 3.67 inches of rain was reported at Rocky Branch, 2.14 inches was reported at Skyland, and 2.05 inches fell at Ida.
May 14, 2002	Trees and power lines were downed by winds that gusted to 58 MPH. A line of showers that produced damaging winds moved south through Northern Virginia between 3:30 and 5:30 PM EDT. In Frederick County, scattered trees and power lines were downed countywide, including the city of Winchester where a wind gust of 58 MPH was recorded. In Clarke County, numerous trees and power lines were downed, especially in the Berryville and Boyce areas. In Loudoun County, a wind gust of 61 MPH was recorded in Sterling at NOVA Community College. Trees and power lines were downed in Lovettsville, Hamilton, Round Hill, and Leesburg. In Lucketts, large trees were downed onto route 663 (Taylorstown Road). In Fairfax County, a tree was downed at the intersection of Route 123 and 236 in Fairfax. In Arlington County, downed trees and localized power outages were reported. In Stafford County, a few trees were downed. In Culpeper County, trees were downed in Culpeper. In Rappahannock County, trees were downed in Sperryville and Castleton. In Madison County, high winds downed trees onto Route 231 North. In Page County, trees were downed in the Luray area. In Shenandoah County, trees were downed in Fort Valley and a telephone pole was

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Date	**Damages**
	downed in Mt. Jackson. A wind gust of 43 MPH was recorded in New Market. In Rockingham County, lines were downed in Timberville. Property damage estimated at $5,000.
June 5, 2002	Scattered thunderstorms moved through northern and central Shenandoah Valley, northern Virginia, the central foot hills, and central Piedmont during the late afternoon and evening of the 5th. In Warren County, trees and power lines were down countywide resulting in numerous power outages. Dime sized hail was reported in Front Royal. In Nineveh, 2.33 inches of rain fell. In Shenandoah County, trees were downed in seven different locations. In Clarke County, trees were downed near Berryville on Route 622.
June 11, 2003	Several trees were downed along Route 7 between Berryville and the Shenandoah River. An area of thunderstorms with high winds, hail, and heavy rainfall moved through the northern half of the state during the afternoon and evening of the 11th. In Nelson County, flooding was reported on the south side of Lovingston. In Augusta County, water was flowing over Route 610 at Stuarts Draft. Trees were downed in New Hope and Middlebrook. In Staunton, numerous streets were turned into rivers by heavy downpours. In Clarke County, several trees were downed along Route 7 between Berryville and the Shenandoah River.
June 12, 2003	Several showers and thunderstorms moved through the northern third of Virginia during the afternoon and evening of the 12th. These storms contained very heavy rainfall and high winds. Several locations reported wind damage and flooding. In Shenandoah County, several roads were flooded. In Clarke County, a tree was downed onto a car near Berryville. Route 50 was closed by flooding 3 miles south of Boyce.
July 12, 2003	Trees were downed onto Bryarly and Gun Club roads. Thunderstorms with high winds and frequent lightning moved through extreme northwest Virginia during the late afternoon and evening of the 12th. In Frederick County, trees were downed onto Bryarly and Gun Club roads just north of Winchester. In Clarke County, trees and power lines were downed in Berryville. In Shenandoah County, high winds blew over or snapped trees in the Forest View area north of Edinburg. The damage was centered around Forest View Road. The Aileen Plant which had lost its roof in a February snowstorm lost a brick wall during this windstorm. Property damage estimated at $3,000.
August 22, 2003	Thunderstorms with damaging winds and large hail moved through Northern Virginia during the evening of the 22nd. In Page County, a downburst of winds estimated between 70 and 80 MPH caused significant damage in Dovel Hollow near Stanley. The wind ripped the roof off of a 45 by 60 foot machine shed, threw it over a two story house, and it finally landed on Dovel Hollow Road nearly 300 yards away. Debris from the shed was thrown into the 2nd story of the home and caused significant damage to the front of the structure. The shed debris also damaged a pickup truck and tore wires off another home. In the vicinity several trees and power lines were also downed. Residents reported one half inch of rainfall in 15 minutes and hail.
August 26, 2011	On September 2, 2011, Governor Robert F. McDonnell requested a major disaster declaration due to Hurricane Irene during the period of August 26-28, 2011. The Governor requested a declaration for Public Assistance for eleven counties and eleven independent cities and Hazard Mitigation for the entire commonwealth. Beginning on August 31, 2011, and continuing, joint federal, commonwealth, and local government Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the commonwealth and the affected local governments, and that Federal assistance is necessary.

Table C-5. Hurricane & High Wind Hazard History

Date	Damages
November 17, 2011	On November 7, 2011, Governor Robert F. McDonnell requested a major disaster declaration due to the Remnants of Tropical Storm Lee during the period of September 8-9, 2011. The Governor requested a declaration for Public Assistance for seven counties and one independent city and Hazard Mitigation for the entire commonwealth. During the period of September 15 to November 4, 2011, joint federal, commonwealth, and local government Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the commonwealth and the affected local governments, and that Federal assistance is necessary.
October 29, 2012; November 26, 2012	On November 16, 2012, Governor Robert F. McDonnell requested a major disaster declaration due to Hurricane Sandy during the period of October 26 to November 8, 2012. The Governor requested a declaration for Individual Assistance for Accomack County, Public Assistance, including direct federal assistance, for 25 counties and three independent cities, and Hazard Mitigation for the entire commonwealth. During the period of November 2-14, 2012, joint federal, commonwealth, and local government Preliminary Damage Assessments (PDAs) were conducted in the requested areas and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the commonwealth and the affected local governments, and that Federal assistance is necessary.
November 02, 2016	On October 20, 2016, Governor Terence R. McAuliffe requested a major disaster declaration due to Hurricane Matthew during the period of October 7-15, 2016. The Governor requested a declaration for Individual Assistance for seven independent cities and two counties and Hazard Mitigation for the entire commonwealth. During the period of October 14-18, 2016, joint federal, commonwealth, and local government Preliminary Damage Assessments (PDAs) were conducted in the requested areas and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the commonwealth and the affected local governments, and that Federal assistance is necessary.

Table C-6. Tornado Hazard History

County	Jurisdiction	Date	Magnitude	Crop Damage	Description
Frederick County	Frederick County	7/13/1961	F2	$0.00	Description not available.
Frederick County	Frederick County	6/2/1962	F1	$0.00	Description not available.
Warren County	Warren County	7/9/1970	F0	$0.00	Description not available.
Clarke County	Clarke County	8/4/1975	F2	0	Description not available.
Clarke County	Clarke County	3/21/1976	F	0	Description not available.
Clarke County	Clarke County	8/2/1986	F1	0	Description not available.
Clarke County	Clarke County	8/2/1986	F1	$0.00	Description not available.
Page County	Town of Stanley	9/27/1993	F1	$0.00	A tornado touched down in Stanley damaging four homes and downing numerous trees and power lines which blocked roads.
Clarke County	Town of Berryville	6/18/1997	F0	$1,000.00	A rapidly developing heavy-precipitation supercell produced several instances of severe weather over portions of the northern Shenandoah Valley and Piedmont regions of Virginia during the late afternoon and evening of the 18th. Four small tornadoes were confirmed. In Clarke Co, a third tornado touched down just south of Berryville. Minor damage was noted to a roof and shingles at a house; an electric garage door was damaged as well. A circular pattern was noted in the tall grass and in branches that had broken off nearby trees. Some tomato stakes and cages were pulled up and tossed. Scattered tree damage was noted elsewhere across the six-county area, including the towns of Reliance (Warren Co), Middletown and Stephens City (Frederick Co), White Post and Berryville (Clarke Co).
Frederick County	Duoble Tollgate	6/18/1997	F0	$2,000.00	The Wheatfield twister (from the heavy precipitated supercell) lifted along the county line, later seen as a funnel near Stephens City (Frederick Co) before dissipating. The second small tornado touched down east of Klines Corner in southeast Frederick Co. Five trees were downed on one farm, and damage was spotty along a 3-mile path to Double Church Road just southwest of Double Tollgate. A spotter had previously reported a touchdown near this area. Most of the damage was to trees, though some minor roof and fence damage was observed along and near Double Church Road.
Shenandoah County	Wheatfield	6/18/1997	F1	$0.00	Damage in Wheatfield was confined to a heavily wooded rural area, where 20 trees were snapped or uprooted along a narrow but distinctive path. Winds were estimated to be around 80 mph. It was the first tornado ever reported in the county; perhaps partially due to a NWS survey team locating the damage. The twister lifted along the county line, later seen as a funnel near Stephens City (Frederick Co) before dissipating.

Table C-6. Tornado Hazard History

County	Jurisdiction	Date	Magnitude	Crop Damage	Description
Clarke County	Berryville	6/2/1998	F0	$0.00	The combination of an upper level disturbance, increasing atmospheric shear, and ample instability set the stage for a severe weather episode across northwestern Virginia during the evening. Individual mini-supercell storms contained large hail, damaging winds, and a few small tornadoes. The storms originated in eastern Ohio during the late afternoon and propagated through southwestern Pennsylvania, extreme northwestern Virginia, and portions of eastern West Virginia before scooting into northern Virginia. Two weak tornadoes, emanating from the same mini-supercell, struck in Clarke and Loudoun Cos. Damage was noted near Berryville (Clarke Co) in the form of several uprooted trees and an unroofed barn. In western Loudoun Co, tree damage indicative of a tornado was surveyed along Snickersville Turnpike (local route 734). Elsewhere in northern Virginia, the main culprit was large hail, ranging in diameter from three-quarters of an inch to golf ball (1.75 inches). Damage likely occurred to some crop fields - the hail, in most cases, lasted from 5 to 15 minutes.
Frederick County	Clear Brook	6/16/1998	F1	$50,000.00	Like a broken record, severe weather erupted again in northern and western Virginia – exactly one day after thunderstorms pounded many of the same areas. This time around, a cold front aided in triggering the episode, though upper-level wind shear was a major player in destabilizing the atmosphere much like it had done the previous day. Incredibly, the 16th would be the third out of four afternoons that severe weather had occurred in some portion of northern and western Virginia. A comma-shaped line of thunderstorms - indicative of a mesoscale low pressure system - developed by the middle of the afternoon. The comma "head" curled from eastern West Virginia into western Maryland, then formed a line through western and central Virginia. Several tornadoes touched down in the vicinity of the comma head, from extreme northwestern Virginia through eastern West Virginia and northern and western Maryland. A small tornado struck in and northeast of Clear Brook (northeast Frederick Co), uprooting at least 7 maple trees, smashing a storm window, flattening a barn, and snapping or uprooting 24 additional trees along Grace Church Road. Allegheny Power reported 2,300 customers lost electricity in Frederick Co alone.
Frederick County	Gainesboro	7/30/1998	F0	$0.00	An isolated rotating thunderstorm developed along a stationary front over western Frederick Co and moved east, producing some wind damage and a small tornado near and east of Gainesboro. At a residence on Hunting Ridge Road just east of Gainesboro, a brief tornado snapped or uprooted 50 to 60 trees, including pines and oaks. One of the trees smashed a portion of a fence. Moments earlier, in Gainesboro, lightning started two grass fires and struck a home, causing minor damage. Strong winds blew down several power lines as well.

Table C-6. Tornado Hazard History					
County	Jurisdiction	Date	Magnitude	Crop Damage	Description
Shenandoah County	Bowman	8/9/2000	F0	$0.00	A 15 yard wide tornado briefly touched down on the banks of the North Fork of the Shenandoah River near Bowman's Crossing. It downed trees and corn as it traveled north for two tenths of a mile. A cold front moved across the region on the evening of the 9th. Thunderstorms that developed ahead and along the front produced winds in excess of 55 MPH, hail, frequent lightning, and isolated tornadoes.
Clarke County	Millwood	5/27/2001	F1	$0.00	A tornado that came from Warren County downed trees across Route 624 (Millville Rd). Two rounds of thunderstorms moved across Northern Virginia on the 27th. The first round crossed the Northern Shenandoah Valley between 1 and 3 PM EDT and produced winds in excess of 55 MPH, dangerous lightning, hail, and a tornado. The tornado moved east-northeast and crossed Route 639 just east of Ashby. Shortly after, it crossed Route 658 just south of White Oak Level and moved into Clarke County at Milldale Road (Route 624). Before exiting the county, the tornado struck three farms just east of Ashby. It tore the tin roof off a barn and threw it 100 yards. A farmhouse suffered a projectile hole and minor damage to trim and a window. The tornado also damaged a silo, several sheds, and small outbuildings. In addition, numerous trees were uprooted and snapped along the tornado's 4 mile long and 100 yard wide path. The tornado remained on the ground for another mile after it crossed into Clarke County at Milldale Road (Route 624), about 3 miles southeast of Stone Bridge. Several trees were downed on the roadway at this location. The tornado traveled to the northeast through woodlands, then dissipated about 5 miles east of Stone Bridge. In addition, a funnel cloud was spotted by a police officer over White Post, north of the tornadic storm. The officer followed the storm that produced the funnel cloud from White Post to Berryville and saw the funnel drop down several times, but never touch the ground. The only damage reported from this storm was from large amounts of golfball sized hail that accumulated up to 6 inches in depth between Double Tollgate and White Post. The large hail damaged an asphalt roof, a flat membrane roof, and light fixtures. It was also responsible for chipping paint off a home and stripping leaves off vegetation.

Table C-6. Tornado Hazard History					
County	**Jurisdiction**	**Date**	**Magnitude**	**Crop Damage**	**Description**
Warren County	Ashby	5/27/2001	F1	$0.00	Two rounds of thunderstorms moved across Northern Virginia on the 27th. The first round crossed the Northern Shenandoah Valley between 1 and 3 PM EDT and produced winds in excess of 55 MPH, dangerous lightning, hail, and a tornado. In Warren County, an F1 tornado touched down around 1 mile southwest of Ashby, just south of Route 639. The tornado moved east-northeast and crossed Route 639 just east of Ashby. Shortly after, it crossed Route 658 just south of White Oak Level and moved into Clarke County at Milldale Road (Route 624). Before exiting the county, the tornado struck three farms just east of Ashby. It tore the tin roof off a barn and threw it 100 yards. A farmhouse suffered a projectile hole and minor damage to trim and a window. The tornado also damaged a silo, several sheds, and small outbuildings. In addition, numerous trees were uprooted and snapped along the tornado's 4 mile long and 100 yard wide path. The tornado remained on the ground for another mile after it crossed into Clarke County at Milldale Road (Route 624), about 3 miles southeast of Stone Bridge.
Shenandoah County	Quicksburg	4/28/2002	F2	$0.00	A long-lived supercell thunderstorm formed over northwest Rockingham County. While the storm moved through North Central Virginia, it produced an F2 tornado in Shenandoah County, a significant funnel cloud in Fauquier County, large hail, heavy downpours, and scattered wind damage. In Shenandoah County, an F2 tornado touched down just east of Quicksburg near the intersection of Quicksburg Road and Old Bridge Road. The tornado stayed on the ground for 4 miles before it dissipated while moving up the west side of Massanutten Mountain. The twister was estimated to be about 75 yards wide and it caused a total of $1.6 million in damage. Along the path of the tornado, three residential structures were destroyed, 12 structures were heavily damaged, and 15 had minor damage. Four poultry houses and 15 barns were destroyed. Five poultry houses, two silos, and a mile of fencing was also damaged. On Old Bridge Road, a silo and three barns were damaged. Airborne roof debris and high winds hit a tractor-trailer on I-81 and caused it to flip onto its side. The driver of the tractor-trailer was treated for minor injuries. The tornado moved across I-81 and Route 11 into the Kay Hill subdivision. Homes were damaged and trees were downed on Lower and Upper Forge Road. A mobile home on Mantz Drive was destroyed. The tornado moved east across Smith Creek to Smith Creek Road and Franwood Lane where it caused significant damage. A two-story home just off Smith Creek Road was severely damaged by debris from a neighbor's 60-foot-high grain silo. A woman inside the structure was treated for bruises. On Franwood Lane, two turkey houses were destroyed and four were severely damaged. One dog that lived on the property was killed and another was injured. A cat was never found. A shed was damaged and work equipment was scattered across the property. At Franwood Farms Airport, 5 people took

Table C-6. Tornado Hazard History					
County	Jurisdiction	Date	Magnitude	Crop Damage	Description
					shelter from the storm in a hangar. A person in the hangar said the walls kept coming closer together as the tornado approached and eventually the roof blew off the building. The tornado also flipped a plane on the landing strip. The tornado's path was visible up to two miles east of Franwood Farms through a path of damaged trees in the forest. The path of tree damage ended as the topography sloped up Massanutten Mountain into George Washington National Forest. In addition, an orchard west of Mt. Jackson just north of the tornado's path, sustained hail damage. Power lines were downed in Stanley. The time series of photos shows the funnel never reaching the ground.
Clarke County	Town of Berryville	9/8/2004	F0	$0.00	A weak tornado touched down briefly just 2 miles north of Berryville and the intersection of Route 7 and U.S. Highway 340. A few trees were snapped off with a lot of shredded leaves on the ground. Maximum winds were around 65 mph.
Frederick County	Town of Middletown	9/17/2004	F1	$0.00	A tornado touched down in western Frederick County, Virginia on the 17th. The path of the storm was 9 miles long. It touched down about one mile east of Middletown and Interstate 81. Roof damage was noted to many barns and outbuildings. A large two story brick garage was nearly destroyed when its roof was blown off from strong F1 tornado winds. In the western end of the Stonebrook Farm Subdivision, an estimated 100 oak and other hardwood trees ranging from 18 to 36 inches in diameter topped or snapped 20 to 50 feet up from the base in roughly a 2 block area. One home was completely destroyed and over 100 others damaged due to falling trees.
Frederick County	Winchester Airport	9/17/2004	F2	$0.00	An F2 tornado produced a nearly continuous path of damage for 5 miles in eastern Frederick County. It touched down west of Millwood Pike near the Winchester Airport. Three homes suffered roof damage, a detached two car garage was destroyed, a platform deck was blown away, an office trailer was overturned, and numerous trees along the track of the storm were uprooted or topped.
Warren County	Town of Front Royal	9/17/2004	F0	$0.00	A weak tornado produced minor damage to some large trees near Front Royal. Debris was thrown across several roads.

Table C-7. Hazardous Material History										
NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
59129	4/12/1990	3124 Valley Ave.	Winchester	Winchester	VA	22601	Rubbermaid Corp.	Fixed	Water	Hydraulic Oil
47741	11/14/1990	320 N Hawksbill	Page	Luray	VA	22835	Wrangler Inc.	Pipeline	Land	Oil, Fuel: No. 5
60463	2/15/1991	Kendrick Ln	Warren	Front Royal	VA	22630	Avtex Fibers	Fixed	Land	Oil, Misc: Transformer
68018	4/11/1991	Hunting Meadows Subdivision Baker-Knight Rd. Between I-81 & Rt. 7	Winchester	Winchester	VA	22601	Jeni Company	Fixed	Water	5 Gallon Tar Buckets
68018	4/11/1991	Hunting Meadows Subdivision Baker-Knight Rd. Between I-81 & Rt. 7	Winchester	Winchester	VA	22601	Jeni Company	Fixed	Water	Old Rusty Drum
68018	4/11/1991	Hunting Meadows Subdivision Baker-Knight Rd. Between I-81 & Rt. 7	Winchester	Winchester	VA	22601	Jeni Company	Fixed	Water	Paint Cans
71229	5/1/1991	St. Rt. 730	Shenandoah	Mount Jackson	VA	(Null)	(Null)	Aircraft	Land	Unknown Material
76001	6/15/1991	Rt 3, Box	Page	Luray	VA	22835	(Null)	Mobile	Land	Oil, Misc: Motor
77911	6/30/1991	Rt 665 Mill Rd	Shenandoah	Woodstock	VA	22664	Woodstock Water Treat Fac	Fixed	Land	Chlorine
83157	8/9/1991	1944 Valley Avenue	Winchester	Winchester	VA	22601	O'sullivan Corporation	Mobile	Water	Topcoat (Vinyl Sheeting Spray)
86156	8/19/1991	State Rt 672	Clarke	Berryville	VA	22611	Mark's Metal Shop	Fixed	Air	Asbestos
88745	9/17/1991	1317 Caroline St	Winchester	Winchester	VA	(Null)	Chemlawn	Mobile	Water	Tank Mix(Fertilizer & Weed Control)
91481	10/6/1991	Off Of Rt 654 Andblackbear Crossing	Shenandoah	Shenandoah	VA	(Null)	(Null)	Fixed	Land	Oil, Misc: Motor
96940	11/20/1991	E King St	Shenandoah	Strasburg	VA	22657	Valley Milk Products	Fixed	Air	Ammonia, Anhydrous
98624	12/6/1991	360 Fox Drive	Winchester	Winchester	VA	22601	(Null)	Fixed	Land	Oil, Fuel: No. 2
102570	1/12/1992	Rt No.672 .6 Of A Mileeast Of Intersection661 And 672	Clarke	Berryville	VA	(Null)	(Null)	Fixed	Land	Polypropylene
112058	3/27/1992	I-81 At Rt 50 Exit	Winchester	Winchester	VA	(Null)	(Null)	Mobile	Land	Oil: Diesel

Table C-7. Hazardous Material History										
NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
118488	5/20/1992	Rt 50 And 340	Clarke	Clarke	VA	(Null)	Lofton's Texaco	Fixed	Land	Gasoline: Automotive (4.23g Pb/G
118976	5/24/1992	York Haven Marinajust Off Browns Neck Rdcounty=Poquoson	Page	Page	VA	23662	(Null)	Vessel	Water	Gasoline: Automotive (4.23g Pb/G
122244	6/17/1992	King David Drive	Warren	Warren	VA	(Null)	(Null)	Mobile	Land	Unknown Oil
126978	7/10/1992	Rt 11 N	Winchester	Winchester	VA	22602	L J Wright	Fixed	Water	Oil: Diesel
127887	7/21/1992	Newport Substation	Page	Shanendoah Town	VA	(Null)	Potomac Edison	Fixed	Land	Oil, Misc: Transformer
133103	8/22/1992	Off Rt 677	Frederick	Frederick	VA	22601	(Null)	Fixed	Water	Citronella, Outdoor Lamp Oil
138183	9/25/1992	522 S Front Royal	Warren	Front Royal	VA	22630	Rappewan Inc	Fixed	Land	Oil: Diesel
142363	10/24/1992	Rt 614behind Baker Trucking	Shenandoah	Mount Jackson	VA	(Null)	Floyd E. Baker Trucking	Mobile	Land	Unknown Oil
148374	12/8/1992	Virginian Truck Stoproute 81mile Marker 291	Shenandoah	Toms Brook	VA	(Null)	Palm Commodities Int	Mobile	Land	Nickel Sulphate Liquid
159410	2/23/1993	1944 Valley Ave	Winchester	Winchester	VA	22601	O'sullivan Corp	Fixed	Land	Methyl Isobutyl Ketone
165334	3/15/1993	Hwy 619	Page	Stanley	VA	22851	(Null)	Fixed	Water	Waste Oil/Lubricants - Poss. Con
162299	3/15/1993	Route 522	Winchester	Winchester	VA	(Null)	Shenandoah Gas Co	Fixed	Air	Ethylene Glycol
163386	3/21/1993	Rt 11 South	Frederick	Middletown	VA	22645	Miles Inc.	Fixed	Land	Trichloroethylene
165766	4/4/1993	Summit Point Rdacross From County Rd 666	Winchester	Winchester	VA	(Null)	(Null)	Fixed	Land	(Null)
166848	4/9/1993	1436 Pack Horse Rd	Winchester	Winchester	VA	22603	(Null)	Unknown Sheen	Water	Unknown Material
167625	4/15/1993	1944 Valley Ave	Winchester	Winchester	VA	22601	Chemical Leman	Mobile	Water	Semi-Gloss Topcoat Vinyl Material
175713	5/23/1993	213 Walton St	Shenandoah	Strasburg	VA	22657	(Null)	Fixed	Land	Kerosene

Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
205784	11/1/1993	Dot No. Unknowncnty Rd Unknown No.	Shenandoah	Strasburg	VA	(Null)	(Null)	Railroad Non-Release	Rail Report (N/A)	(Null)
210161	11/29/1993	Route 3 Box 370	Shenandoah	Shenandoah	VA	22824	Rocco Farm Foods Inc	Fixed	Air	Chlorine
212412	12/13/1993	1944 Valley Ave	Winchester	Winchester	VA	22601	O Sullivan Corp	Mobile	Water	Oil, Fuel: No. 2-D
215928	1/9/1994	(Null)	Warren	Warren	VA	(Null)	Norfolk Southern Railroad	Railroad	Land	Oil, Misc: Lubricating
218024	1/22/1994	Between The Shannondoahcompressor Station & Thebickers Compressor Sta	Page	Page	VA	(Null)	Columbia Gas Transmisson	Pipeline	Air	Natural Gas
231789	3/2/1994	Corner Of Steps To Heavenand Dooms Peak	Warren	Warren	VA	22642	Skyland Estates	Mobile	Land	Oil, Misc: Motor
231789	3/2/1994	Corner Of Steps To Heavenand Dooms Peak	Warren	Warren	VA	22642	Skyland Estates	Mobile	Land	Oil: Diesel
236922	4/27/1994	501 Stickley Dr	Frederick	Stephens City	VA	22655	(Null)	Mobile	Water	Oil, Misc: Motor
242208	6/3/1994	Avtex Fiberskendrick Lane	Warren	Front Royal	VA	(Null)	(Null)	Fixed	Land	Unknown Oil(Unknown Type Fuel Oil)
244131	6/15/1994	(Null)	Shenandoah	Shenandoah	VA	(Null)	Norfolk Southern	Railroad	Land	Hydraulic Oil
244113	6/15/1994	(Null)	Shenandoah	Strasburg	VA	(Null)	Norfolk Southern	Fixed	Land	Hydraulic Oil
250802	7/20/1994	Rt 34522 Northnorth Fork Of Shenandoahriver (Vic. Bridge)	Warren	Front Royal	VA	22651	(Null)	Unknown Sheen	Water	Unknown Material
257478	8/25/1994	1944 Valley Ave	Winchester	Winchester	VA	22601	All Frieght	Mobile	Land	Paint
258917	9/3/1994	Leroy's Marinalittle Wicomoco River	Clarke	Clarke	VA	(Null)	M/V Ballroom Buddy	Vessel	Water	Gasoline: Automotive (Unleaded)
262375	9/25/1994	1944 Valley Ave	Winchester	Winchester	VA	22601	O Sullivan Corp	Fixed	Land	Acetone
262375	9/25/1994	1944 Valley Ave	Winchester	Winchester	VA	22601	O Sullivan Corp	Fixed	Land	Methyl Ethyl Ketone
272303	12/7/1994	(Null)	Winchester	Winchester	VA	(Null)	(Null)	Mobile	Unknown	(Null)
272746	12/10/1994	St Rte 661dot 468631w	Warren	Warren	VA	(Null)	(Null)	Railroad Non-Release	Rail Report (N/A)	(Null)

Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
273013	12/12/1994	Route 3 Box 5940route 608	Clarke	Berryville	VA	(Null)	Glenn Owen	Fixed	Air	Creosote, Coal Tar
274680	12/28/1994	304 Liberty St	Clarke	Berryville	VA	66211	Mercer's Oil Co	Fixed	Land	Oil, Fuel: No. 2
282848	3/11/1995	1944 Valley Ave	Winchester	Winchester	VA	22601	O'sullivan Corp	Fixed	Water	Mobilsol A
288921	4/27/1995	Middle Rd And Rte 55	Frederick	Stephens City	VA	(Null)	(Null)	Unknown Sheen	Land	Oil, Fuel: No. 2-D
290102	5/5/1995	Intersection Of State Rt703 And Route 11	Shenandoah	Mount Jackson	VA	(Null)	(Null)	Railroad Non-Release	Land	Oil, Fuel: No. 2-D
308642	9/25/1995	1944 Valley Ave	Winchester	Winchester	VA	22601	Manfredi Motor Transit	Mobile	Water	Solvent
314349	11/15/1995	Ricketts Dr And Southloudoun St	Winchester	Winchester	VA	22601	(Null)	Unknown Sheen	Water	Unknown Oil
321457	1/20/1996	Across River Fm Thefront Royal County Clubon East Side	Warren	Front Royal	VA	(Null)	(Null)	Fixed	Water	Unknown Material
322275	1/25/1996	Strasburg Handymart232 West King St	Shenandoah	Strasburg	VA	(Null)	Hn Funkhouser & Co	Fixed	Water	Kerosene
328776	2/22/1996	1502 Martinburg Pike	Winchester	Winchester	VA	(Null)	Amoco Foam Products	Fixed	Land	Ethyl Chloride
330624	3/12/1996	(Null)	Page	Shanendoah Town	VA	(Null)	Norfolk Southern	Railroad	Land	Oil, Misc: Lubricating
330797	3/12/1996	Pawaton Rd	Shenandoah	Strasburg	VA	(Null)	Ag Mark	Fixed	Air	Unknown Material
354614	8/2/1996	1502 Martinburg Pike	Winchester	Winchester	VA	(Null)	Amoco Foam Products	Fixed	Air	Ethyl Chloride
358453	8/26/1996	1502 Martinburg Pike	Winchester	Winchester	VA	(Null)	Amoco Foam Products	Fixed	Air	Ethyl Chloride
362162	9/9/1996	Rt 616pole #F1334sa22	Page	Page	VA	(Null)	Virginia Power	Fixed	Water	Oil, Misc: Transformer (Unknown If Pcb)
368458	11/23/1996	404 Kendrick Lane	Warren	Front Royal	VA	(Null)	Epa Iii	Fixed	Water	Untreated Discharge Water From Lagoon
371690	12/29/1996	Mp H-106rail Yard	Page	Shanendoah Town	VA	30303	Norfolk Southern Rr	Railroad	Land	Oil, Fuel: No. 2-D

Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
378528	2/28/1997	811 Junior Ave	Page	Shanendoah Town	VA	(Null)	Jvk Precision	Fixed	Land	Waste Oil
397200	7/29/1997	(Null)	Page	Stanley	VA	(Null)	Norfolk Southern	Fixed	Land	Oil, Misc: Transformer(Pcb Content Unknown)
397207	7/29/1997	(Null)	Page	Stanley	VA	(Null)	(Null)	Fixed	Land	Polychlorinated Biphenyls
407329	10/10/1997	Lake Holiday Country Club231 Redland Rd	Frederick	Frederick	VA	(Null)	(Null)	Vessel	Water	Gasoline: Automotive (4.23g Pb/G
407329	10/10/1997	Lake Holiday Country Club231 Redland Rd	Frederick	Frederick	VA	(Null)	(Null)	Vessel	Water	Oil, Misc: Motor
408266	10/20/1997	On Access Road Leading Tojohns Manvillemanufacturing	Shenandoah	Shenandoah	VA	22824	Johns Manville	Fixed	Water	Asphalt(Emulsion)
409810	10/31/1997	No Address	Page	Shanendoah Town	VA	(Null)	Norfolk Southern Rr	Railroad	Land	Oil, Misc: Lubricating
409825	10/31/1997	505 First St	Page	Shanendoah Town	VA	(Null)	Norfolk Southern	Railroad	Land	Oil, Misc: Lubricating
415412	12/11/1997	Hwy 340	Page	Stanley	VA	22851	Wompler Foods	Fixed	Air	Chlorine
425998	2/25/1998	5 Longstreet Ave	Clarke	Clarke	VA	(Null)	(Null)	Fixed	Land	Oil, Fuel: No. 2
425951	2/25/1998	450 Old Depo Rd.	Shenandoah	New Market	VA	(Null)	Kennametal	Fixed	Water	Trim-Vhpe 210 , Miscible
439016	5/28/1998	First St	Page	Shanendoah Town	VA	(Null)	Lcm Inc	Railroad	Land	Naphtha: Solvent
439567	6/1/1998	1502 Martinsburg Pike	Winchester	Winchester	VA	(Null)	Tenneco Packing Co	Fixed	Air	Ethyl Chloride
444848	7/7/1998	1502 Martinsburg Pike	Winchester	Winchester	VA	(Null)	Tenneco Packing Co	Fixed	Air	Ethyl Chloride
451148	8/14/1998	227 Conincille Roadi-81 Exit 273	Shenandoah	Mount Jackson	VA	(Null)	Sheetz Inc	Unknown Sheen	Water	Oil: Diesel
457212	9/25/1998	3rd House On The Left Oncedar Lane	Clarke	Clarke	VA	20135	(Null)	Fixed	Water	Oil: Diesel
460278	10/16/1998	Route 3, Box 5980	Clarke	Berryville	VA	22611	Mercer Oil Co	Fixed	Land	Unknown Oil
461686	10/28/1998	(Null)	Page	Shanendoah Town	VA	(Null)	Norfolk Southern Corp	Railroad	Land	Lube Oil

Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
466401	12/4/1998	(Null)	Shenandoah	Shanendoah Town	VA	(Null)	Norfolk Southern Rr	Railroad	Land	Borate
479108	4/3/1999	Virginia Divisionmm H107.4	Page	Shanendoah Town	VA	(Null)	Norfolk Southern Rr	Railroad	Land	Oil, Misc: Lubricating
504558	6/3/1999	2840 Us Highway 211 East	Page	Luray	VA	22835	Brookside Restaurant	Fixed	Water	Gray Water
495372	8/13/1999	Fairfax Pike Or Route 277and Stephens City	Frederick	Stephens City	VA	22655	Wes's Truck And Trailor	Fixed	Air	Refrigerant Gases
495385	8/17/1999	Vacant Lot In 170 Blockon Bixler Ferry Road	Page	Luray	VA	(Null)	Town Of Luray	Fixed	Land	Construction Trash (Broken Glass/Steel/Asphalt/Cement)
495883	8/21/1999	Milepost H106.7	Page	Shanendoah Town	VA	(Null)	Norfolk Southern Rr	Railroad	Land	Aggregate Limestone
497991	9/8/1999	605 North Louden Street	Winchester	Winchester	VA	22601	Winchester Cold Storage	Fixed	Air	Ammonia, Anhydrous
500614	9/28/1999	522 North	Frederick	Frederick	VA	(Null)	(Null)	Vessel	Water	Gasoline: Automotive (Unleaded)
505472	11/11/1999	I-81 At Exit 323flying J	Frederick	Frederick	VA	(Null)	Crst International	Mobile	Water	Oil, Fuel: No. 2-D
509589	12/20/1999	Route 684	Winchester	Winchester	VA	(Null)	Quarles Petroleum Inc	Mobile	Air	Propane
520836	2/15/2000	Flying J Truck Stophwy 181 North	Winchester	Winchester	VA	(Null)	Flying J Truck Stop	Fixed	Land	Raw Sewage
520836	2/15/2000	Flying J Truck Stophwy 181 North	Winchester	Winchester	VA	(Null)	Flying J Truck Stop	Fixed	Land	Unknown Oil
521125	2/22/2000	246 Dick's Hollow Rd	Winchester	Winchester	VA	22603	(Null)	Fixed	Water	Oil, Fuel: No. 2-D
521507	2/29/2000	1114 Fairfax Pikebuilding One	Frederick	Stephens City	VA	22655	Wes's Truck And Trailer Repair	Fixed	Water	Ethylene Glycol
521507	2/29/2000	1114 Fairfax Pikebuilding One	Frederick	Stephens City	VA	22655	Wes's Truck And Trailer Repair	Fixed	Water	Oil, Misc: Motor
521507	2/29/2000	1114 Fairfax Pikebuilding One	Frederick	Stephens City	VA	22655	Wes's Truck And Trailer Repair	Fixed	Water	Oil: Diesel

Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
525960	4/11/2000	806 Us Hwy 340just To The Left Of The Scalehouse By The Dumpsters	Page	Luray	VA	(Null)	Page County Landfill	Fixed	Water	Battery Acid
525960	4/11/2000	806 Us Hwy 340just To The Left Of The Scalehouse By The Dumpsters	Page	Luray	VA	(Null)	Page County Landfill	Fixed	Water	Waste Oil
527930	5/3/2000	I-81 South	Warren	Strasburg	VA	(Null)	Dupre Transport Inc.	Mobile	Soil	Oil, Fuel: No. 2-D
528335	5/7/2000	1117 Lakeview Drive	Frederick	Frederick	VA	22625	(Null)	Pipeline	Water	Raw Sewage
537757	8/5/2000	Truck Stop On Main Street In Stevens City5116 Main Street	Frederick	Stephens City	VA	(Null)	High Point Truck Stop	Fixed	Land	Oil, Fuel: No. 2
579562	9/12/2000	Avtex Superfund Sitekedrick Lane	Warren	Front Royal	VA	(Null)	Fmc Corp.	Fixed	Air	Carbon Disulfide
579562	9/12/2000	Avtex Superfund Sitekedrick Lane	Warren	Front Royal	VA	(Null)	Fmc Corp.	Fixed	Air	Hydrogen Sulfide
579562	9/12/2000	Avtex Superfund Sitekedrick Lane	Warren	Front Royal	VA	(Null)	Fmc Corp.	Fixed	Air	Sulfuric Acid
543190	9/25/2000	109 Blue Bell Ave	Page	Luray	VA	22835	Bridge Terminal Transport	Mobile	Water	Oil: Diesel
546542	10/25/2000	Across From 135 N. Main St	Shenandoah	Woodstock	VA	22664	Woodstock Fire Company	Fixed	Air	Gasoline: Automotive (Unleaded)
546630	10/28/2000	Mcdonald Road	Winchester	Winchester	VA	(Null)	(Null)	Fixed	Land	Waste Oil
548533	11/17/2000	Off Of Rte 620	Clarke	Clarke	VA	(Null)	(Null)	Fixed	Water	Oil, Misc: Transformer
551739	12/21/2000	1014 Mt Olive Rd	Shenandoah	Toms Brook	VA	22660	A.T. Williams Oil Company	Storage Tank	Land	Oil, Fuel: No. 2-D
554326	1/21/2001	1014 Mt Olive Rd	Shenandoah	Toms Brook	VA	22660	A.T. Williams Oil Company, Inc.	Storage Tank	Unknown	Oil, Fuel: No. 2-D
559845	3/10/2001	Right Off West Maine St, On Kendrick Lane	Warren	Front Royal	VA	(Null)	(Null)	Fixed	Air	Unknown Material
573088	7/16/2001	440 Kindred Lane	Warren	Front Royal	VA	22630	Fmc Corp	Pipeline	Water	Impacted Storm Waters
576338	8/12/2001	I-81 / Mile Marker 279	Shenandoah	Mount Jackson	VA	(Null)	Western Express	Mobile	Land	Oil, Fuel: No. 2-D
582106	10/5/2001	On The Track	Warren	Front Royale	VA	(Null)	(Null)	Railroad	Ballast	Calcium Chloride

Table C-7. Hazardous Material History

NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
584990	11/2/2001	704 Woodlawn Ave.	Warren	Front Royal	VA	(Null)	Valley Discount Fuel	Fixed	Land	Oil, Fuel: No. 2-D
585417	11/7/2001	Industrial Park	Shenandoah	Mount Jackson	VA	(Null)	Merlot Cabinet	Fixed	Air	Unknown Material
587312	11/29/2001	1696 Oranda Rdpob 7151	Shenandoah	Strasburg	VA	22657	Global Stone Chemstone	Fixed	Soil	Oil, Fuel: No. 2-D
587952	12/6/2001	6347 Winchester Rd (Rte 522)	Warren	Warren	VA	(Null)	(Null)	Storage Tank	Water	Unknown Oil
590599	1/2/2002	Within The The Processing Plant19992 Senedo Rd	Shenandoah	Shenandoah	VA	22824	Georgia's Chicken	Pipeline	Air	Ammonia, Anhydrous
601383	4/30/2002	Sub Stationintersection Of Rt 675 And Rt 779	Shenandoah	Shenandoah	VA	(Null)	(Null)	Fixed	Land	Oil, Misc: Transformer (Non Pcb)
619137	8/6/2002	158 West Parkins Mill Road	Winchester	Winchester	VA	(Null)	West Parkins Mill Water Treatment Facili	Storage Tank	Air	Chlorine
619179	8/6/2002	Parkins Mill Waste Water Treatment Plant158 West Parkins Mill Road	Winchester	Winchester	VA	(Null)	Frederick County Sanitation Authority	Storage Tank	Air	Chlorine
622039	9/4/2002	1226 N Frederick Pike	Winchester	Winchester	VA	(Null)	(Null)	Fixed	Land	Transmission Fluid
626908	9/20/2002	Private Well107 Tee Court	Warren	Warren	VA	22642	(Null)	Fixed	Water	Polychlorinated Biphenyls
625771	10/11/2002	I-81 South At Mile Marker 271.5.	Shenandoah	Mount Jackson	VA	(Null)	Trl	Mobile	Water	Oil: Diesel
640049	3/20/2003	1944 Valley Ave.	Winchester	Winchester	VA	(Null)	Poly One Corp	Mobile	Water	Hydraulic Oil
641424	4/5/2003	In Front Of Below Address203 Juniper Drive	Warren	Front Royal	VA	(Null)	(Null)	Fixed	Water	Oil, Misc: Motor
650797	7/14/2003	7961 Winchester Rd	Warren	Fort Royal	VA	22630	Dupont	Storage Tank	Land	Clear Coat(Company Product)
652150	7/27/2003	550 Fairmont Ave	Winchester	Winchester	VA	(Null)	National Fruit Products Company	Fixed	Air	Ammonia, Anhydrous
652379	7/30/2003	Devil Jump.	Page	Luray	VA	(Null)	(Null)	Pipeline	Water	Raw Sewage

Table C-7. Hazardous Material History

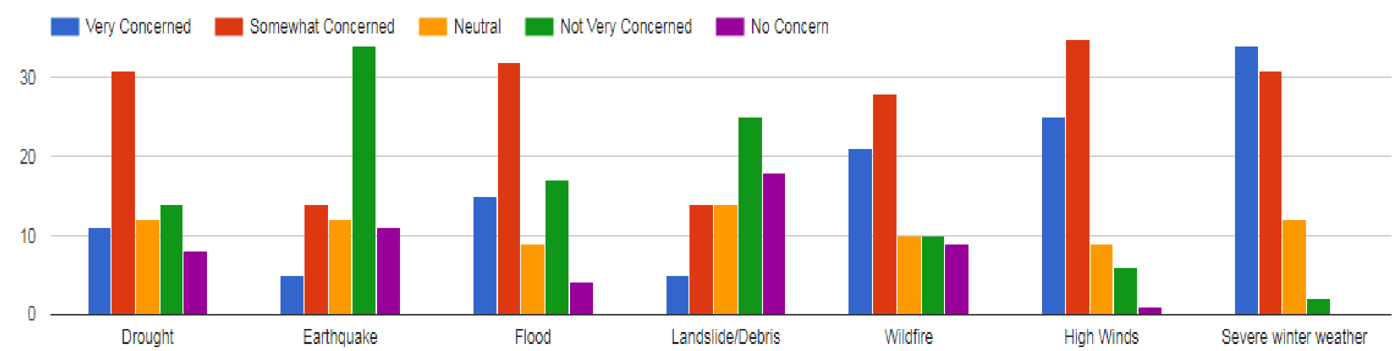
NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
652666	8/1/2003	National Fruit Product Warehouse Building 37a550 Fairmont Avenue	Winchester	Winchester	VA	22601	A & S Transport	Mobile	Water	Oil, Fuel: No. 2-D
652877	8/4/2003	Railroad Milepost H53.0 / Subdivision: Virginia	Warren	Warren	VA	(Null)	Norfolk Southern Railroad	Railroad	Ballast	Hydraulic Oil
654741	8/22/2003	550 Fairmont Avenue	Winchester	Winchester	VA	22601	National Fruit Product Co.	Fixed	Air	Ammonia, Anhydrous
701421	9/25/2003	427 North Cameron St	Winchester	Winchester	VA	(Null)	Zirkle Sheet Metal Incorp.	Fixed	Air	Freon
705330	11/14/2003	Shenandoah County Municpal Landfill	Shenandoah	Shenandoah	VA	(Null)	Shenandoah County Municpal Landfill	Fixed	Air	Refrigerant Gases
707088	12/3/2003	I-81 South Bound At Exit 315	Winchester	Winchester	VA	(Null)	Penatere Brothers Inc	Mobile	Land	Oil, Fuel: No. 2-D
711758	1/28/2004	Us 340 Maintenance St., Milepost H95.5	Page	Stanley	VA	(Null)	Norfolk Southern Railroad	Mobile	Ballast	Hydraulic Oil
712515	2/3/2004	Medianroute 66 Westbound, Milemarker 11	Warren	Front Royale	VA	(Null)	Burgess Trucking	Mobile	Water	Oil, Fuel: No. 2-D
712515	2/3/2004	Medianroute 66 Westbound, Milemarker 11	Warren	Front Royale	VA	(Null)	Burgess Trucking	Mobile	Water	Oil, Misc: Motor
715634	3/7/2004	256 Mason St.	Winchester	Winchester	VA	(Null)	(Null)	Storage Tank	Water	Oil, Fuel: No. 2
719330	4/19/2004	312 Walnut St.	Clarke	Clarke	VA	22611	Mercer Oil	Storage Tank	Land	Oil, Fuel: No. 2
721042	5/7/2004	545 Radio Station Road	Shenandoah	Strasburg	VA	22657	(Null)	Mobile	Land	Oil: Diesel
723280	5/27/2004	Milepost B45.6 On Westbound Main Track Of Norfolk Southern	Warren	Front Royal	VA	(Null)	Norfolk Southern	Railroad	Ballast	Tylex
723269	5/27/2004	Mm: B-45.2	Warren	Warren	VA	(Null)	Norfolk Southern Railroad	Railroad	Land	Oil: Diesel
724177	6/7/2004	7961 Winchester Rd	Warren	Fort Royal	VA	22630	Dupont	Railroad	Land	Solvent Blend
724456	6/9/2004	311 North Commerce Street	Warren	Front Royal	VA	22630	(Null)	Fixed	Land	Chlorine
733171	8/20/2004	Chicken Processing Plant - Corner Of East Old Cross & Johns Seviercorner Of East Old Cross & Johns Sevier	Shenandoah	New Market	VA	(Null)	Chicken Processing Plant	Fixed	Air	Ammonia, Anhydrous
733331	8/26/2004	Lakepost Road	Clarke	Clarke	VA	(Null)	(Null)	Storage Tank	Land	Unknown Oil

Table C-7. Hazardous Material History

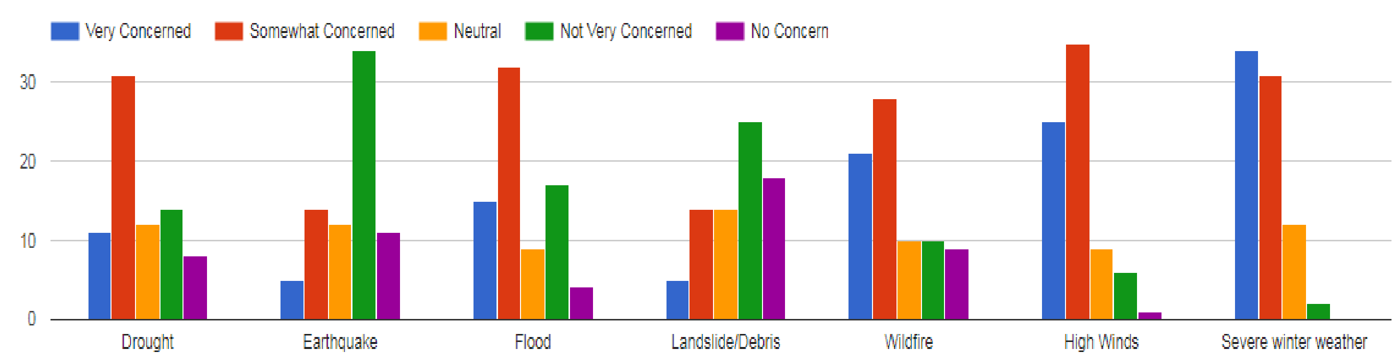
NRC Report#	Incident Date	Street	Location County	City	State	ZIP	Suspected Responsible Company	Type Of Incident	Medium Affected	Material Name
737965	10/11/2004	Norfolk Southern Railyard Mile Post H-106.3	Page	Shanendoah Town	VA	(Null)	(Null)	Mobile	Land	Hydraulic Oil
739774	10/24/2004	11829 Orkney Grade	Shenandoah	Mount Jackson	VA	22842	(Null)	Storage Tank	Water	Oil, Fuel: No. 2
752601	3/13/2005	Rail Yard, Milepost H-106	Page	Shanendoah Town	VA	(Null)	Norfolk Southern Railroad	Railroad	Ballast	Soy Holls (Type Of Feed)
754222	3/30/2005	Mile Post H106	Page	Shanendoah Town	VA	(Null)	(Null)	Railroad	Ballast	Crank Case Oil
757892	5/6/2005	Milepost H-95.0	Page	Stanley	VA	(Null)	Norfolk Southern Railroad	Railroad	Ballast	Oil, Misc: Lubricating
776979	10/21/2005	I-81 Sb Near Mm 272	Shenandoah	Mount Jackson	VA	(Null)	Estes Express Line	Mobile	Land	Oil, Fuel: No. 2-D
777096	10/22/2005	Unknown Sheen Incident, Happy Creek, Jackson Street, Near The Bridge	Warren	Front Royal	VA	(Null)	(Null)	Unknown Sheen	Water	Unknown Oil
777595	10/26/2005	Mile B46.0	Warren	Front Royal	VA	(Null)	Norfolk Southern Railroad	Railroad	Soil	Oil: Diesel

Appendix D – Public Outreach Questions & Results

Please rate your level of concern, regarding the risk of the following natural disasters affecting YOUR community.



Please rate your level of concern, regarding the risk of the following natural disasters affecting YOUR community.

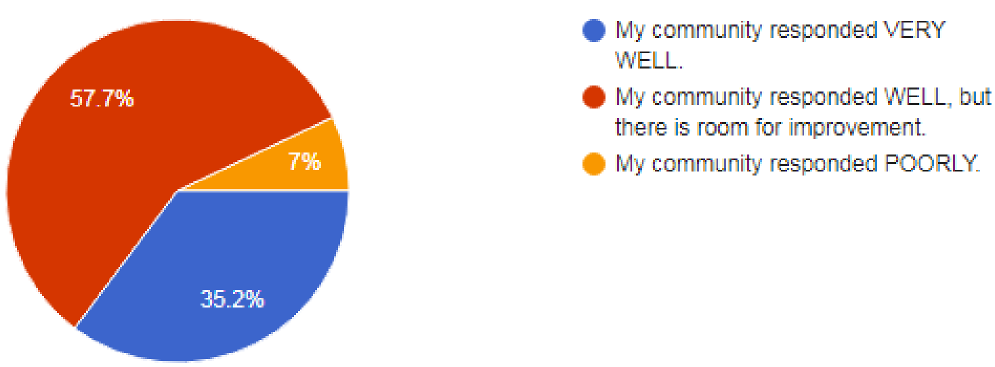


Are you concerned about any hazard that was not listed in the previous question? If so, please list them here:

County landfill
terrorism and influx from DC
Long term disruption to power grid- natural or man-made
N/A
Power grid failure, Pandemic
Asteroids, Volcano eruption, Air Pollution, Water Contamination, Solar Flares.
Hazardous material spill or leak
Public Health related Emergency
Long-term power outage
Nuclear diaster; health epidemics such as influenza, Ebola, etc.

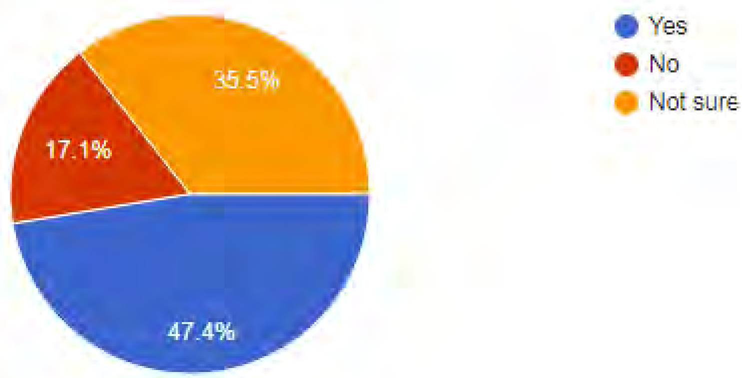
Has your community ever experienced any of the hazards listed above? If so, how would you rate your community official's response in providing emergency relief?

71 responses



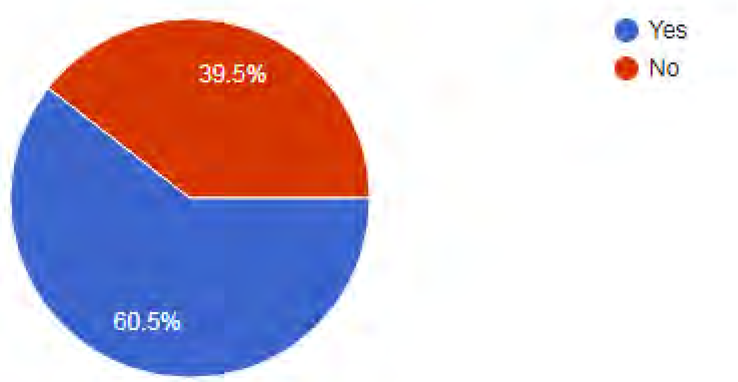
Do you feel that your community will be able to effectively respond and recover IF disaster strikes tomorrow?

76 responses



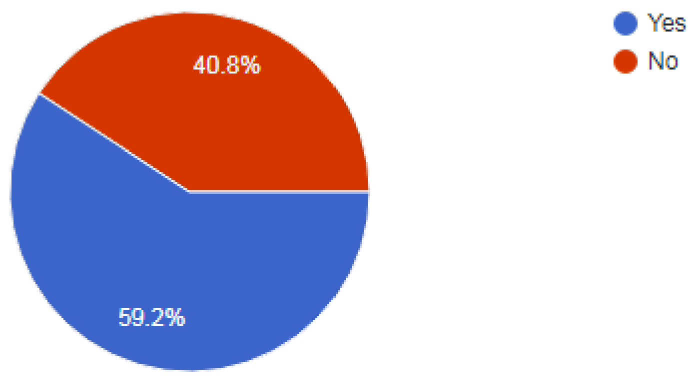
Do you feel adequately informed about all of the hazards that may threaten your community?

76 responses

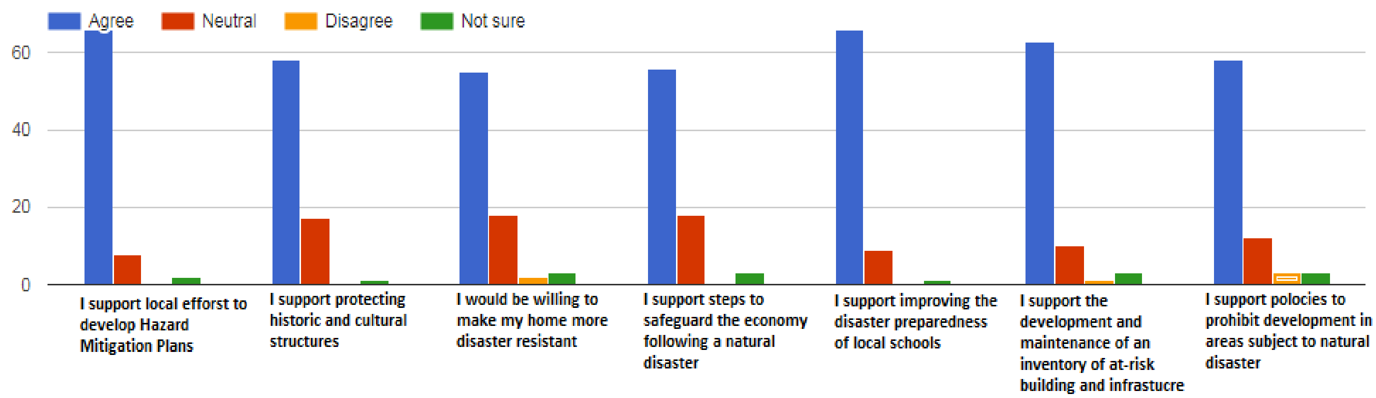


Have you ever received information about how to make members of your household and your home safe from natural disasters?

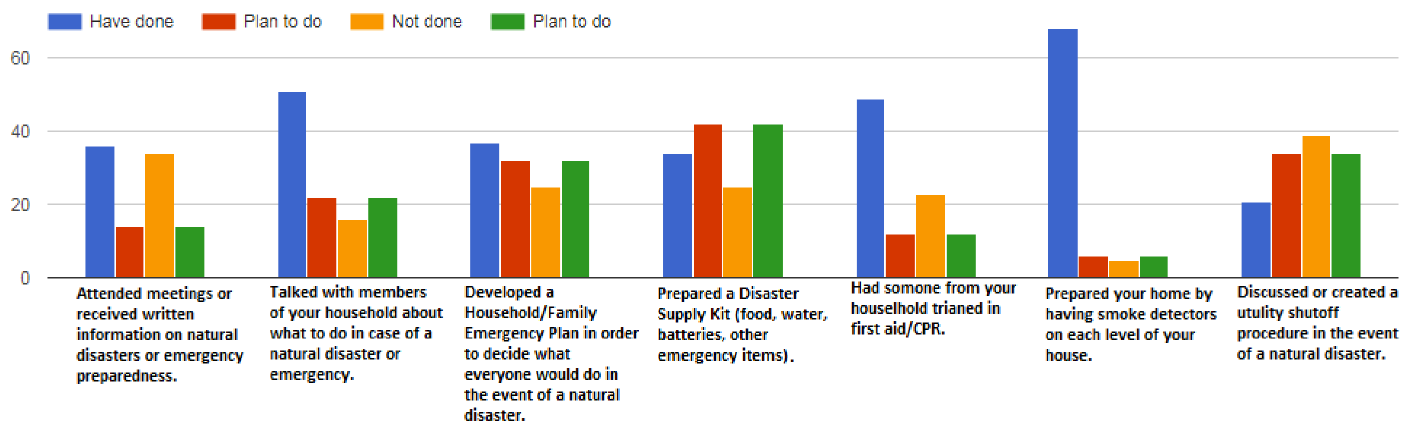
76 responses



A number of activities can reduce your community's risk from natural hazards. These activities can be both regulatory and non-regulatory. Please check the box that best represents your opinion of the following strategies to reduce the risk and loss associated with natural disasters.



In the following list, please check those activities that you have done in your household, plan to do in the near future, have not done, or are unable to do. (Please check one answer for each preparedness activity)



Please feel free to leave any additional comments in the space provided:

4 responses

There's quite a bit of room for improvement for community level disaster preparedness in the Winchester/Frederick areas- from better organizing neighborhoods to coordinate & respond to needs in times of crisis, pet/animal-rescue emergency response along with professionalizing the entire fire fighting/life saving system (shift from volunteer to professional career paid positions), finally reduce reliance on military donations in law enforcement because these will most certainly be what will roll out in to our neighborhoods should a large scale disaster strike! No bueño! p.s. the last multiple choice question above has a typo- ...in the event...

Winchester City cant even remove moderate amounts of snow from city streets, snow removal trucks don't even have chains, expect no improvements with disaster response.

Board of Supervisors needs to support and get personally involved in local disaster drills.

LEPC should be more accessible to the public. Seems it works in a vacuum

Appendix E – Meeting Agendas/Minutes

NSVRC
NORTHERN SHENANDOAH VALLEY REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017

MEETING AGENDA

07/12/2017

2:00 – 2:05	Introductions
2:05 – 2:10	Importance of Hazard Mitigation
2:10 – 2:25	Updating the Hazard Mitigation Plan
2:25 – 2:35	Current status of update
2:35 – 2:45	Update timeline
2:45 – 3:00	Team responsibilities and data needs
3:00 – 3:15	Incorporation of other regional plans
3:15 – 3:30	Future meetings/open discussion

Hazard mitigation documents and updated figures are posted for review on the NSVRC's Hazard Mitigation page:
http://www.nsvregion.org/hazard-mitigation.html/

NORTHERN SHENANDOAH VALLEY REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017
NSVRC
400 E Kendrick Ln, Front Royal, VA 22630
2:00pm - 07/12/2017

Kick Off Meeting Attendees - NSVRC Office, 2pm, 07/12/2017		
Name	**Title**	**Jurisdiction/Organization**
Alex Berryman	Planner/Zoning Administrator	Town of New Market
Gina DiCicco	Floodplain Planner	VA DCR
Richard Mabie	Regional Planner	VDEM
Lemuel Hancock	Fire Chief/Emergency Management	Town of Woodstock
Dan Harshman	Planner/Zoning Administrator	Town of Edinburg
Chester T. Lauck	Deputy Emergency Management Coordinator	Frederick County
Taryn Logan	Planning Director	Warren County
Matt Wendling	Floodplain Manager	Warren County
Brian Lichty	Director Fire-Rescue	Clarke County
Jill Jefferson	Planner	Shenandoah County
Lynn A. Miler	Emergency Management Coordinator	City of Winchester
Jason Pagan	Emergency Management Coordinator	City of Winchester
John Crockett	Planner	NSVRC

MEETING MINUTES

1. **Administrative Items:**
   - Welcome and introductions – The meeting began with a round of introductions by the 13 attendees.
   - Review of project details, expectations, and action items.
   - Distribution of items to be discussed at next meeting:
     - Memorandum of Agreement to participate in plan update
     - Hazard Summary worksheet
     - Sample Public Opinion Survey worksheet
     - Capability Assessment worksheet.
2. **Review of timeline:**
   - It was agreed that the group will continue to meet monthly on the 2nd Wednesday at 2pm in the NSVRC's Front Royal office conference room.
   - A unanimous motion was made to adjust the project timeline to meet the current plan's April 2018 expiration. Mr. Crockett will make adjustment and re-distribute to planning group/post to web portal.
3. **Other Business:**
   - The importance of including a dam inventory was addressed – a GIS database will be developed by Mr. Crockett to expand on the plan's current catalog of regional critical infrastructure.
   - A request was made to research possible public events for presenting the plan update to the public – A calendar of possible events will be generated by Mr. Crockett, for discussion at the next meeting.

The meeting adjourned at 3:30pm.

NSVRC
NORTHERN SHENANDOAH VALLEY REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017
MEETING AGENDA

08/09/2017

2:00 – 2:15	Hazard Summary Worksheet 5.1 Review
2:15 – 2:35	Public Opinion Survey Worksheet 3.1 Review
2:35 – 2:55	Capability Assessment Worksheet 4.1 Review
2:55 – 3:05	Safe Growth Audit – Reducing Vulnerability to Future Development
3:05 – 3:15	NFIP Compliance worksheet
3:15 – 3:30	Future Meetings/Open discussion

Hazard mitigation documents and updated figures are posted for review on the NSVRC's Hazard Mitigation page:
http://www.nsvregion.org/hazard-mitigation.html/

NSVRC
NORTHERN SHENANDOAH VALLEY REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017
NSVRC
400 E Kendrick Ln, Front Royal, VA 22630
2:00pm - 08/09/2017

Meeting Attendees - NSVRC Office, 2pm, 08/09/2017		
Name	**Title**	**Jurisdiction/Organization**
Brian Lichty	EM Coordinator	Clarke County
Chester Lauck	Deputy EM Coordinator	Frederick County
Jill Jefferson	Planner	Shenandoah County
Lemuel Hancock	Planner	Town of Woodstock
Dennis Utterback	Town Manager	Town of Boyce
Rick Farrall	Deputy EM Coordinator	Warren County
Lynn Miller	EM Coordinator	City of Winchester
Matt Wendling	Planner	Warren County

MEETING MINUTES

1. **Review of Hazard Summary Worksheet 5.1:**
   - This meeting ultimately served as a review of the current hazards list
   - The hazard map portal was presented and can be accessed through the hazard mitigation page on the NSVRC website
   - Final hazard rankings will be determined after review of public opinion survey

The meeting adjourned at 3:30pm.

NSVRC
NORTHERN SHENANDOAH VALLEY
REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017
MEETING AGENDA

09/13/2017

2:00 – 2:15	Public Opinion Survey/Public Outreach (Continued Discussion)
2:15 – 2:45	Safe Growth Audit Worksheet 4.2 Review
2:45 – 3:15	National Flood Insurance Worksheet 4.3 Review
3:15 – 3:30	Future Meetings/Open Discussion

Hazard mitigation documents and updated figures are posted for review on the NSVRC's Hazard Mitigation page:
http://www.nsvregion.org/hazard-mitigation.html/

NSVRC
NORTHERN SHENANDOAH VALLEY REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017
NSVRC
400 E Kendrick Ln, Front Royal, VA 22630
2:00pm - 09/13/2017

Meeting Attendees - NSVRC Office, 2pm, 08/09/2017		
Name	**Title**	**Jurisdiction/Organization**
Catharine Hughes	Planner	VDEM
Chester Lauck	Deputy EM Coordinator	Frederick County
Jill Jefferson	Planner	Shenandoah County
Justin Ferrell	LHEC	VDH – LFHD
Rick Farrall	Deputy EM Coordinator	Warren County
Lynn Miller	EM Coordinator	City of Winchester
Matt Wendling	Planner	Warren County
Kristin Owen	Planner/State CRS	VA DCR
Gina DIcicco	Planner	VA DCR
John Crockett	Planner	NSVRC

MEETING MINUTES

1. **Review of Public Opinion Survey/Outreach Strategy:**
   Action Items:
   - Add introduction to survey explaining importance and reasoning
   - Add note about recent storm events to survey to help garner interest
   - Adjust timeline to allow for time to better execute and results – Dec. 1
   - Remove questions regarding use of tax money
   - Change wording as to not be suggestive of excessive regulation or government overreach

2. **Review of Safe Growth Audit:**
   Action Items:
   - Distribute fillable PDF versions of Safe Growth Audit and Capability Assessment
   - Reach out to jurisdictions that have been absent from meetings

- Final Review of Safe Growth Audit will coincide with review of Capability Assessment

3. Review of NFIP Worksheet:

   Action Items:

   - Reach out to jurisdictions that have been absent
   - Investigate Boyce FIRMS

The meeting adjourned at 3:30pm.

NSVRC
NORTHERN SHENANDOAH VALLEY
REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017
MEETING AGENDA

10/11/2017

Individual meetings held to help review requirements for the jurisdictional needs packet distributed.

Hazard mitigation documents and updated figures are posted for review on the NSVRC's Hazard Mitigation page:
http://www.nsvregion.org/hazard-mitigation.html/

NSVRC
NORTHERN SHENANDOAH VALLEY
REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017

MEETING AGENDA

11/08/2017

2:00 – 2:30	Review of Public Opinion Survey results
2:30 – 2:45	Discuss any further public outreach
2:45 – 3:00	Discuss needs for completing final draft
3:00 – 3:30	Future Meetings/Open Discussion

Hazard mitigation documents and updated figures are posted for review on the NSVRC's Hazard Mitigation page:
http://www.nsvregion.org/hazard-mitigation.html/

NSVRC
NORTHERN SHENANDOAH VALLEY REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017

NSVRC

400 E Kendrick Ln, Front Royal, VA 22630

2:00pm - 11/08/2017

Meeting Attendees - NSVRC Office, 2pm, 11/08/2017		
Name	**Title**	**Jurisdiction/Organization**
Chester Lauck	Deputy EM Coordinator	Frederick County
Justin Ferrell	LHEC	VDH – LFHD
Rick Farrall	Deputy EM Coordinator	Warren County
Jill Jefferson	Planner	Shenandoah County
Lynn Miller	EM Coordinator	City of Winchester
John Crockett	Planner II	NSVRC

MEETING MINUTES

1. **Review of Public Opinion Survey Results**

   It was determined that we were obtaining good results via GoogleDocs, but could use higher numbers

   Action Items:
   - Continue survey through until December meeting/final draft
   - Increase promotion

2. **Further Public outreach discussion:**

   Action Items:
   - Develop press release to help garner more responses
   - Invite media to next week's NEVPT meeting and add Haz Mit to meeting agenda

3. **Needs for completing final draft:**

   A final needs packet was distributed to each jurisdictional representative that addressed specific items addressed in the plan

   Action Items:
   - Complete and review needs packet
   - Incorporate any changes/updates to plan draft

4. **Future Meetings/Open Discussion:**

   Action Items:
   - Reach out to jurisdictions that have been absent

The meeting adjourned at 3:30pm.

NSVRC
NORTHERN SHENANDOAH VALLEY REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017

MEETING AGENDA

12/20/2017

2:00 – 2:15	Distribute the update final draft and review guide
2:15 – 2:30	Discuss any further items necessary for state submittal
2:30 – 3:00	Future Meetings/Open Discussion

Hazard mitigation documents and updated figures are posted for review on the NSVRC's Hazard Mitigation page:

http://www.nsvregion.org/hazard-mitigation.html/

NSVRC
NORTHERN SHENANDOAH VALLEY
REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017
NSVRC
400 E Kendrick Ln, Front Royal, VA 22630
2:00pm – 12/20/2017

Meeting Attendees - NSVRC Office, 2pm, 11/08/2017		
Name	**Title**	**Jurisdiction/Organization**
Chester Lauck	Deputy EM Coordinator	Frederick County
Catherine Hughes	All Hazards Planner	VDEM
Rick Farrall	Deputy EM Coordinator	Warren County
John Crockett	Planner II	NSVRC

MEETING MINUTES

1. **Distribute updated draft and review guide**

   Updated draft was distributed for jurisdictional review

   Action Items:

   - A rough outline of the final push for completing draft was presented whereas March 31, 2018 is the goal for approval from state

2. **Discuss any further items necessary for state submittal:**

   Action Items:

   - Working on a tight turnaround, jurisdictions were encouraged to promote the plan and make aware it will be presented for adoption in the coming months

3. **Future Meetings/Open Discussion:**

   Action Items:

   - Reach out to jurisdictions that have been absent

The meeting adjourned at 3:30pm.

NSVRC
NORTHERN SHENANDOAH VALLEY
REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017
MEETING AGENDA

01/10/2018

2:00 – 2:15	Distribute the updated draft and review regulation checklist
2:15 – 2:30	Discuss any further items necessary for state submittal
2:30 – 3:00	Future Meetings/Open Discussion

Hazard mitigation documents and updated figures are posted for review on the NSVRC's Hazard Mitigation page:
http://www.nsvregion.org/hazard-mitigation.html/

NSVRC
NORTHERN SHENANDOAH VALLEY REGIONAL COMMISSION

Northern Shenandoah Valley Regional Hazard Mitigation Plan Update 2017
NSVRC
400 E Kendrick Ln, Front Royal, VA 22630
2:00pm – 01/10/2018

Meeting Attendees - NSVRC Office, 2pm, 01/10/2018		
Name	**Title**	**Jurisdiction/Organization**
Chester Lauck	Deputy EM Coordinator	Frederick County
Catherine Hughes	All Hazards Planner	VDEM
Rick Farrall	Deputy EM Coordinator	Warren County
Lynn Miller	EM Coordinator	City of Winchester
John Crockett	Planner II	NSVRC

MEETING MINUTES

1. **Distribute updated draft and review guide**

   Updated draft was again distributed for jurisdictional review

   Action Items:
   - Confirmed goal of March 31st approval
   - Review jurisdictional calendars to determine dates for adoption

2. **Discuss any further items necessary for state submittal:**

   Action Items:
   - Continue to promote the plan throughout jurisdictions and make aware that it will be presented for adoption in the coming months

3. **Future Meetings/Open Discussion:**

   Action Items:
   - Reach out to jurisdictions that have been absent

The meeting adjourned at 3:30pm.

Appendix F – NFIP Repetitive Loss Properties

Northern Shenandoah Valley Region NFIP Repetitive Loss Properties								
Locality	Occupancy	Zone	Insured (Y/N)	Building Value	Total Building Payment	Losses	Total Paid	Average Paid
BASYE	SINGLE FMLY	EMG	N	$37,486.40	$11,500.00	2	$48,986.40	$24,493.20
BASYE	SINGLE FMLY	A	N	$21,210.73	$0.00	3	$21,210.73	$7,070.24
BERRYVILLE	SINGLE FMLY	C	N	$38,573.14	$3,938.64	2	$42,511.78	$21,255.89
BERRYVILLE	SINGLE FMLY	C	N	$109,240.61	$49,606.10	2	$158,846.71	$79,423.36
BERRYVILLE	SINGLE FMLY	C	N	$18,259.78	$93.40	2	$18,353.18	$9,176.59
BERRYVILLE	SINGLE FMLY	A	N	$32,179.80	$0.00	2	$32,179.80	$16,089.90
BERRYVILLE	SINGLE FMLY	C	N	$6,832.25	$6,126.25	2	$12,958.50	$6,479.25
CLARKE COUNTY	SINGLE FMLY	C	N	$65,798.45	$16,500.00	3	$82,298.45	$27,432.82
DEER RAPIDS	SINGLE FMLY	A	N	$19,442.79	$3,092.60	2	$22,535.39	$11,267.70
EDINBURG	SINGLE FMLY	A	N	$49,139.14	$3,258.41	3	$52,397.55	$17,465.85
EDINBURG	SINGLE FMLY	AE	N	$98,682.57	$2,058.30	2	$100,740.87	$50,370.44
EDINBURG	SINGLE FMLY	A	N	$39,454.21	$12,842.93	2	$52,297.14	$26,148.57
EDINBURG	SINGLE FMLY	A	N	$24,068.08	$7,160.56	2	$31,228.64	$15,614.32
EDINBURG	SINGLE FMLY	A	N	$32,085.58	$0.00	3	$32,085.58	$10,695.19
EDINBURG	SINGLE FMLY	A	N	$39,132.97	$0.00	3	$39,132.97	$13,044.32
EDINBURG	SINGLE FMLY	A	N	$101,612.26	$5,798.84	2	$107,411.10	$53,705.55
EDINBURGH	SINGLE FMLY	X	N	$14,639.46	$1,640.55	2	$16,280.01	$8,140.01
EDINBURGH	SINGLE FMLY	A04	N	$27,771.92	$20,400.00	3	$48,171.92	$16,057.31
ESTATES	SINGLE FMLY	A28	N	$78,702.98	$6,900.00	5	$85,602.98	$17,120.60
FLINT	SINGLE FMLY	A	N	$12,544.35	$0.00	2	$12,544.35	$6,272.18

Northern Shenandoah Valley Region NFIP Repetitive Loss Properties *(continued)*								
FRONT ROYAL	SINGLE FMLY	A	N	$42,228.85	$14,984.06	2	$57,212.91	$28,606.46
FRONT ROYAL	SINGLE FMLY	A	N	$22,712.80	$0.00	2	$22,712.80	$11,356.40
FRONT ROYAL	SINGLE FMLY	A	N	$69,558.68	$23,863.05	2	$93,421.73	$46,710.87
FRONT ROYAL	SINGLE FMLY	B	Y	$47,974.33	$10,000.00	2	$57,974.33	$28,987.17
FRONT ROYAL	SINGLE FMLY	C	N	$28,083.32	$9,982.38	2	$38,065.70	$19,032.85
FRONT ROYAL	SINGLE FMLY	A21	N	$38,620.23	$3,548.94	2	$42,169.17	$21,084.59
FRONT ROYAL	SINGLE FMLY	A	N	$53,460.53	$1,730.04	3	$55,190.57	$18,396.86
FRONT ROYAL	SINGLE FMLY	A	N	$72,506.05	$30,712.46	3	$103,218.51	$34,406.17
FRONT ROYAL	SINGLE FMLY	A28	N	$64,153.61	$54,184.38	2	$118,337.99	$59,169.00
FRONT ROYAL	SINGLE FMLY	AE	N	$58,806.23	$8,889.18	3	$67,695.41	$22,565.14
FRONT ROYAL	SINGLE FMLY	B	N	$57,025.77	$11,129.48	3	$68,155.25	$22,718.42
FRONT ROYAL	SINGLE FMLY	AE	N	$53,821.61	$0.00	2	$53,821.61	$26,910.81
FRONT ROYAL	SINGLE FMLY	A28	N	$81,268.11	$18,346.10	2	$99,614.21	$49,807.11
FRONT ROYAL	SINGLE FMLY	A21	N	$74,483.90	$0.00	3	$74,483.90	$24,827.97
FRONT ROYAL	SINGLE FMLY	A	N	$20,440.77	$954.80	2	$21,395.57	$10,697.79
FRONT ROYAL	SINGLE FMLY	A	Y	$36,533.96	$0.00	2	$36,533.96	$18,266.98
FRONT ROYAL	SINGLE FMLY	B	N	$85,036.52	$38,973.50	2	$124,010.02	$62,005.01
FRONT ROYAL	SINGLE FMLY	A	N	$51,532.64	$21,332.26	2	$72,864.90	$36,432.45
FRONT ROYAL	SINGLE FMLY	A	N	$85,348.89	$10,000.00	2	$95,348.89	$47,674.45
FRONT ROYAL	SINGLE FMLY	AE	N	$156,457.05	$82,782.95	4	$239,240.00	$59,810.00
FRONT ROYAL	SINGLE FMLY	A	N	$2,520.81	$15,367.90	2	$17,888.71	$8,944.36
FRONT ROYAL	SINGLE FMLY	B	N	$30,109.52	$19,158.51	2	$49,268.03	$24,634.02
FRONT ROYAL	SINGLE FMLY	A24	N	$56,053.80	$11,104.50	4	$67,158.30	$16,789.58

Northern Shenandoah Valley Region NFIP Repetitive Loss Properties *(continued)*								
FRONT ROYAL	SINGLE FMLY	A21	N	$57,343.28	$20,851.96	3	$78,195.24	$26,065.08
FRONT ROYAL	SINGLE FMLY	A	N	$27,813.52	$0.00	2	$27,813.52	$13,906.76
FRONT ROYAL	OTHR-NONRES	A	N	$71,454.94	$12,362.50	2	$83,817.44	$41,908.72
FRONT ROYAL	SINGLE FMLY	A	N	$76,935.58	$27,120.62	3	$104,056.20	$34,685.40
FRONT ROYAL	SINGLE FMLY	B	N	$22,060.01	$6,000.00	2	$28,060.01	$14,030.01
FRONT ROYAL	SINGLE FMLY	A	N	$114,550.35	$28,400.00	4	$142,950.35	$35,737.59
FRONT ROYAL	SINGLE FMLY	A	N	$58,627.69	$8,326.50	2	$66,954.19	$33,477.10
FRONT ROYAL	SINGLE FMLY	A28	N	$14,647.04	$13,115.07	2	$27,762.11	$13,881.06
FRONT ROYAL	SINGLE FMLY	A28	N	$114,269.85	$9,081.16	3	$123,351.01	$41,117.00
FRONT ROYAL	SINGLE FMLY	AE	N	$118,360.77	$4,612.88	6	$122,973.65	$20,495.61
FRONT ROYAL	SINGLE FMLY	A	N	$30,912.86	$0.00	2	$30,912.86	$15,456.43
FRONT ROYAL	SINGLE FMLY	A25	N	$47,096.10	$9,557.24	3	$56,653.34	$18,884.45
FRONT ROYAL	SINGLE FMLY	B	N	$53,893.18	$13,525.00	3	$67,418.18	$22,472.73
FRONT ROYAL	SINGLE FMLY	B	N	$126,988.71	$30,647.00	3	$157,635.71	$52,545.24
FRONT ROYAL	ASSMD CONDO	B	Y	$18,671.02	$7,226.05	2	$25,897.07	$12,948.54
FRONT ROYAL	SINGLE FMLY	A28	N	$68,948.69	$46,237.00	3	$115,185.69	$38,395.23
FRONT ROYAL	SINGLE FMLY	AE	N	$27,190.12	$0.00	2	$27,190.12	$13,595.06
FRONT ROYAL	SINGLE FMLY	B	Y	$7,777.15	$4,833.53	2	$12,610.68	$6,305.34
FRONT ROYAL	SINGLE FMLY	B	N	$3,299.84	$0.00	2	$3,299.84	$1,649.92
FRONT ROYAL	SINGLE FMLY	A	N	$48,278.80	$18,518.66	2	$66,797.46	$33,398.73
FRONT ROYAL	SINGLE FMLY	B	N	$37,032.55	$18,400.13	2	$55,432.68	$27,716.34
FRONT ROYAL	SINGLE FMLY	A	N	$18,863.48	$15,297.64	2	$34,161.12	$17,080.56
FRONT ROYAL	SINGLE FMLY	A	N	$57,872.32	$18,019.44	2	$75,891.76	$37,945.88

Northern Shenandoah Valley Region NFIP Repetitive Loss Properties *(continued)*								
FRONT ROYAL	SINGLE FMLY	B	N	$51,882.70	$16,776.45	2	$68,659.15	$34,329.58
FRONT ROYAL	SINGLE FMLY	A	N	$21,702.10	$18,398.89	5	$40,100.99	$8,020.20
FRONT ROYAL	SINGLE FMLY	EMG	N	$24,901.19	$1,923.93	2	$26,825.12	$13,412.56
FRONT ROYAL WAR	SINGLE FMLY	A	Y	$17,199.05	$0.00	2	$17,199.05	$8,599.53
JHNSTN MAG DIST	SINGLE FMLY	A	N	$123,316.85	$17,820.09	2	$141,136.94	$70,568.47
LURAY	SINGLE FMLY	X	N	$46,689.02	$25,000.00	2	$71,689.02	$35,844.51
LURAY	SINGLE FMLY	X	N	$33,603.53	$14,170.68	2	$47,774.21	$23,887.11
LURAY	SINGLE FMLY	X	N	$6,576.97	$0.00	2	$6,576.97	$3,288.49
LURAY	SINGLE FMLY	A	N	$30,692.91	$15,248.97	4	$45,941.88	$11,485.47
LURAY	SINGLE FMLY	X	N	$61,629.10	$14,704.05	4	$76,333.15	$19,083.29
LURAY	SINGLE FMLY	C	N	$23,641.91	$8,084.71	2	$31,726.62	$15,863.31
LURAY	SINGLE FMLY	A	N	$97,846.39	$19,201.69	2	$117,048.08	$58,524.04
LURAY	SINGLE FMLY	A	N	$113,815.74	$41,301.70	2	$155,117.44	$77,558.72
LURAY	SINGLE FMLY	AE	N	$4,966.22	$0.00	2	$4,966.22	$2,483.11
LURAY	SINGLE FMLY	A	N	$50,778.89	$6,359.93	2	$57,138.82	$28,569.41
LURAY	SINGLE FMLY	A	N	$50,856.82	$20,000.00	2	$70,856.82	$35,428.41
LURAY	SINGLE FMLY	X	N	$28,857.11	$10,105.98	2	$38,963.09	$19,481.55
MAURERTOWN	SINGLE FMLY	A	Y	$53,313.14	$9,459.69	2	$62,772.83	$31,386.42
MAURERTOWN	SINGLE FMLY	A	Y	$34,260.12	$5,406.80	2	$39,666.92	$19,833.46
MAURERTOWN	SINGLE FMLY	C	Y	$85,966.36	$9,941.85	2	$95,908.21	$47,954.11
MAURERTOWN	SINGLE FMLY	A	N	$45,968.57	$0.00	2	$45,968.57	$22,984.29
MAURERTOWN	SINGLE FMLY	C	N	$164,568.00	$108,732.45	3	$273,300.45	$91,100.15
MAURERTOWN	SINGLE FMLY	A	Y	$44,344.07	$0.00	2	$44,344.07	$22,172.04

Northern Shenandoah Valley Region NFIP Repetitive Loss Properties *(continued)*								
MAURERTOWN	SINGLE FMLY	A	N	$29,835.63	$6,058.04	2	$35,893.67	$17,946.84
MAURERTOWN	SINGLE FMLY	A	N	$25,906.78	$9,023.16	2	$34,929.94	$17,464.97
MAURERTOWN	SINGLE FMLY	A	N	$41,589.01	$0.00	2	$41,589.01	$20,794.51
MAURERTOWN	SINGLE FMLY	A	N	$77,314.53	$12,388.95	2	$89,703.48	$44,851.74
MT JACKSON	SINGLE FMLY	A	Y	$53,450.20	$0.00	3	$53,450.20	$17,816.73
NEW MARKET	SINGLE FMLY	A	N	$52,117.76	$7,500.00	2	$59,617.76	$29,808.88
RILEYVILLE	SINGLE FMLY	X	N	$13,673.85	$6,446.85	2	$20,120.70	$10,060.35
SHENANDOAH	SINGLE FMLY	A	N	$16,915.87	$0.00	2	$16,915.87	$8,457.94
SHENANDOAH	SINGLE FMLY	A	Y	$47,893.54	$25,605.42	2	$73,498.96	$36,749.48
SHENANDOAH	SINGLE FMLY	A	N	$20,193.36	$3,985.40	2	$24,178.76	$12,089.38
SHENANDOAH CO	SINGLE FMLY	C	Y	$138,868.08	$31,208.85	3	$170,076.93	$56,692.31
SHENANDOAH FARM	SINGLE FMLY	A25	N	$48,576.00	$15,767.00	2	$64,343.00	$32,171.50
SHENANDOAH SHRS	SINGLE FMLY	A28	N	$57,270.74	$0.00	2	$57,270.74	$28,635.37
STRASBURG	SINGLE FMLY	A	N	$30,106.87	$3,400.00	3	$33,506.87	$11,168.96
STRASBURG	SINGLE FMLY	A	N	$97,877.07	$0.00	2	$97,877.07	$48,938.54
STRASBURG	SINGLE FMLY	A	N	$44,548.92	$1,063.32	3	$45,612.24	$15,204.08
STRASBURG	SINGLE FMLY	A	N	$52,078.66	$14,652.00	2	$66,730.66	$33,365.33
STRASBURG	SINGLE FMLY	A	Y	$55,186.92	$43,734.49	2	$98,921.41	$49,460.71
STRASBURG	SINGLE FMLY	A	N	$29,371.77	$9,391.20	2	$38,762.97	$19,381.49
STRASBURG	SINGLE FMLY	X	N	$55,763.82	$7,550.65	2	$63,314.47	$31,657.24
STRASBURG	SINGLE FMLY	C	Y	$54,651.99	$30,267.40	2	$84,919.39	$42,459.70
STRASBURG	SINGLE FMLY	C	N	$85,222.17	$28,361.31	2	$113,583.48	$56,791.74
STRASBURG	SINGLE FMLY	A	N	$78,299.08	$3,200.00	3	$81,499.08	$27,166.36

Northern Shenandoah Valley Region NFIP Repetitive Loss Properties *(continued)*

STRASBURG	SINGLE FMLY	A	N	$85,527.05	$27,476.33	2	$113,003.38	$56,501.69
STRASBURG	SINGLE FMLY	C	Y	$75,034.60	$51,971.29	2	$127,005.89	$63,502.95
STRASBURG	SINGLE FMLY	A	N	$29,452.10	$0.00	2	$29,452.10	$14,726.05
STRASBURG	SINGLE FMLY	A	N	$20,620.30	$0.00	2	$20,620.30	$10,310.15
TOMS BROOK	SINGLE FMLY	A	Y	$25,267.18	$0.00	2	$25,267.18	$12,633.59
UPPERVILLE	SINGLE FMLY	C	N	$26,708.47	$3,549.22	2	$30,257.69	$15,128.85
VALLEY RD LURAY	SINGLE FMLY	A	N	$31,629.77	$7,274.77	2	$38,904.54	$19,452.27
WARREN	SINGLE FMLY	A28	N	$34,955.13	$15,496.95	2	$50,452.08	$25,226.04
WARREN	OTHR-NONRES	A	N	$14,214.28	$5,470.11	2	$19,684.39	$9,842.20
WARREN	SINGLE FMLY	A28	N	$51,430.38	$0.00	3	$51,430.38	$17,143.46
WARREN	SINGLE FMLY	A21	N	$68,548.19	$14,215.04	3	$82,763.23	$27,587.74
WARREN CO	SINGLE FMLY	B	N	$36,666.09	$4,600.00	2	$41,266.09	$20,633.05
WARREN COUNTY	SINGLE FMLY	A	N	$39,824.39	$11,497.37	2	$51,321.76	$25,660.88
WARREN COUNTY	SINGLE FMLY	A	N	$20,004.16	$9,408.25	2	$29,412.41	$14,706.21
WARREN COUNTY	SINGLE FMLY	A	N	$47,923.80	$0.00	2	$47,923.80	$23,961.90
WINCHESTER	OTHR-NONRES	A	N	$30,859.09	$72,704.13	3	$103,563.22	$34,521.07
WINCHESTER	SINGLE FMLY	X	Y	$3,093.44	$127.41	2	$3,220.85	$1,610.43
WINCHESTER	OTHR-NONRES	EMG	UNK	$0.00	$4,687.50	2	$4,687.50	$2,343.75
WINCHESTER	SINGLE FMLY	EMG	UNK	$7,724.05	$7,737.24	2	$15,461.29	$7,730.65
WINCHESTER	OTHR-NONRES	EMG	N	$20,962.17	$72,097.11	4	$93,059.28	$23,264.82
WOODSTOCK	SINGLE FMLY	A	N	$56,800.00	$10,000.00	2	$66,800.00	$33,400.00
WOODSTOCK	OTHR-NONRES	A	N	$13,001.63	$322,900.00	2	$335,901.63	$167,950.82
WOODSTOCK	SINGLE FMLY	X	N	$18,072.45	$6,800.00	2	$24,872.45	$12,436.23

Northern Shenandoah Valley Region NFIP Repetitive Loss Properties *(continued)*								
WOODSTOCK	SINGLE FMLY	A	Y	$67,173.97	$14,308.17	2	$81,482.14	$40,741.07
WOODSTOCK	SINGLE FMLY	A	N	$163,337.73	$23,584.43	2	$186,922.16	$93,461.08
WOODSTOCK	SINGLE FMLY	A	Y	$32,716.08	$15,385.76	2	$48,101.84	$24,050.92
Northern Shenandoah Valley Region NFIP SEVERE Repetitive Loss Properties								
FRONT ROYAL	SINGLE FMLY	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FRONT ROYAL	SINGLE FMLY	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FRONT ROYAL	SINGLE FMLY	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LURAY	SINGLE FMLY	N/A	N/A	N/A	N/A	N/A	N/A	N/A

NFIP Repetitive Loss Properties – Source: Virginia Department of Emergency Management (VDEM)

Federal Emergency Management Agency
National Flood Insurance Program

OMB 1660-0022 EXPIRES August 31, 2010

NFIP REPETITIVE LOSS (RL) UPDATE WORKSHEET (AW-501)

NOTE: SEE REVERSE SIDE FOR MITIGATION ACTION CODES AND PAPERWORK BURDEN STATEMENT

Printed On: THE INFORMATION ON THIS FORM IS BASED ON CLAIMS ON OR BEFORE:

REPETITIVE LOSS NUMBER:

Internal use only ☐ A ☐ N/A ☐ FRR

CURRENT NFIP COMMUNITY NAME:								
COMMUNITY ID # :								
CURRENT PROPERTY ADDRESS				PREVIOUS PROPERTY ADDRESS/COMMUNITY ID #				
LAST CLAIMANT:								
INSURED: NAMED INSURED:								
DATES OF LOSSES					TOTAL NUMBER OF LOSSES FOR PROPERTY:			

REQUESTED UPDATES

MARK ALL UPDATES BELOW THAT APPLY **(IMPORTANT – READ THE INSTRUCTIONS)**

1.☐ INFORMATION PROVIDED NOT SUFFICIENT TO IDENTIFY PROPERTY.
Choose this update if all attempts to locate the property fail. Please describe the steps you took to locate the property in the comments section below.

2.☐ COSMETIC CHANGES REQUIRED TO THE ADDRESS: ________________
Use this update to correct or update the property address shown above. Only change the address not the name.

3.☐ PROPERTY NOT IN OUR COMMUNITY OR JURISDICTION:
Choose this update if you have positively determined that the property shown is not located in your community. Please provide the correct community name and if known the NFIP Community ID Number. If available, please attach a map showing the property location.

ASSIGN TO COMMUNITY NAME: ________________ NFIP COMMUNITY ID # ________

4.☐ FLOOD PROTECTION PROVIDED.
Choose this update only if some type of structural intervention has occurred to the building, property or the source of flooding that protects the building from future events similar to those that occurred in the past. The correction must be supported by documentation such as an Elevation Certificate and the Mitigation information below must be provided.

Mitigation Action 1.) ☐ **Source of Mitigation Funding 3.)** ☐ **See the back of this form for the appropriate codes.**

5.☐ NO BUILDING ON PROPERTY.
Choose this update only if the property in question can be positively identified as the site of the previously flooded building and documentation is available to support that an insurable building no longer exists at this site. The correction must be supported by documentation such as a Demolition or Relocation Permit and the Mitigation information below must be provided.

Mitigation Action 2.) ☐ **Source of Mitigation Funding 3.)** ☐ **See the back of this form for the appropriate codes.**

6.☐ DUPLICATE LISTING WITH RL NUMBER: ____________ COMBINE AS ONE LISTING.
Choose this update to identify two or more separate listings that are for the same building. List all other RL numbers that are duplicates to this property. Please indicate which address shown is the correct address to use.

7.☐ HISTORIC BUILDING: Check this box if you know the building is listed on a State or National Historic Registry.

ADDITIONAL COMMENTS: ________________________

A SIGNED RL TRANSMITTAL SHEET MUST ACCOMPANY THIS FORM FOR APPOVAL OF THE UPDATE!

SEE PRIVACY ACT STATEMENT ON THE BACK

MITIGATION ACTION CODES

1.) If you checked the box that says "FLOOD PROTECTION PROVIDED," please enter the letter below (a –f) that best describes the situation:

a. The building was elevated to or above the Base Flood Elevation (BFE).
b. The building was elevated but not to the BFE.
c. The building (non-residential) was floodproofed to the BFE.
d. The building was partially floodproofed (but, not to the BFE).
e. The building was protected by a flood control/stormwater management project.
f. The building was replaced by a new elevated/floodproofed building.

2.) If you checked the box that says "NO BUILDING ON PROPERTY," please enter the letter below (g – i) that best describes the situation.

g. The building was demolished, but not acquired through any program.
h. The building was acquired and demolished as part of a program.
i. The building was relocated out of the floodplain.

MITIGATION FUNDING CODES

3.) Please choose from the following (j – y) to identify the primary and secondary funding sources for the mitigation action described by a – i above.

FEMA PROGRAMS	NON FEMA FUNDING SOURCES
j. Hazard Mitigation Grant Program (HMGP) k. Flood Mitigation Assistance Program (FMA). l. Pre-Disaster Mitigation Grant Program (PDM). m. Repetitive Flood Claims (RFC) n. Severe Repetitive Loss Program (SRL) o. Section 1362 Acquisition Program. p. Other FEMA Programs	q. Increased Cost of Compliance (ICC) coverage. r. U.S. Housing & Urban Development (HUD) Community Development Block Grant (CDBG). s. U.S. Army Corps of Engineers or Natural Resources Conservation Service (NRCS) Project. t. Other Federal Program. u. State Program. v. Local Program. w. Property Owner x. Natural Disaster or Fire. y. Unknown

Appendix G - HAZUS-MH County 100 year Flood Global Assessments – (Town Level/Census Block Analysis Results Available upon request, contact NSVRC – 540-636-8800)

Clarke County:

Hazus-MH: Flood Global Risk Report

Region Name: Clarke

Flood Scenario: 100

Print Date: Monday, February 05, 2018

Disclaimer:

This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Virginia

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is approximately 178 square miles and contains 1,262 census blocks. The region contains over 6 thousand households and has a total population of 14,034 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 6,400 buildings in the region with a total building replacement value (excluding contents) of 2,207 million dollars. Approximately 90.84% of the buildings (and 84.28% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 6,400 buildings in the region which have an aggregate total replacement value of 2,207 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,859,838	84.3%
Commercial	178,129	8.1%
Industrial	89,601	4.1%
Agricultural	15,022	0.7%
Religion	25,990	1.2%
Government	16,823	0.8%
Education	21,209	1.0%
Total	**2,206,612**	**100%**

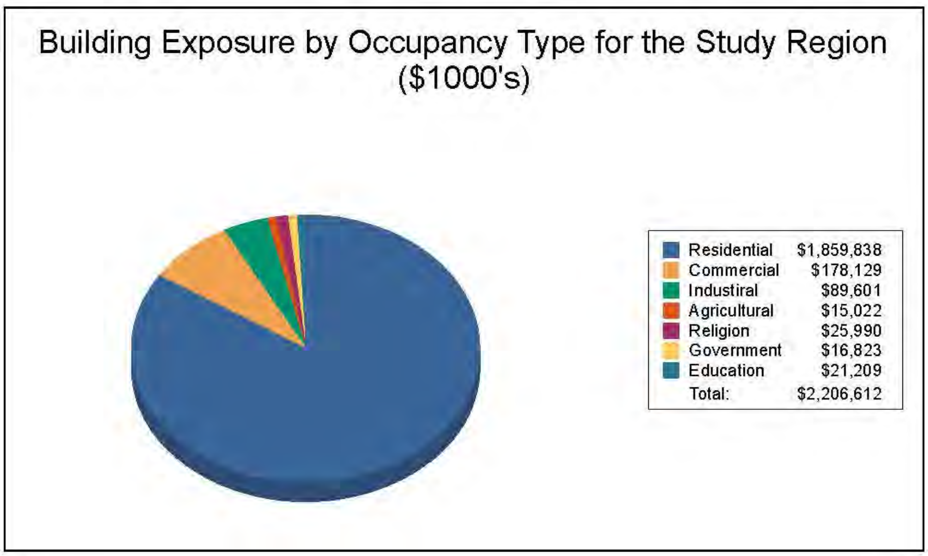
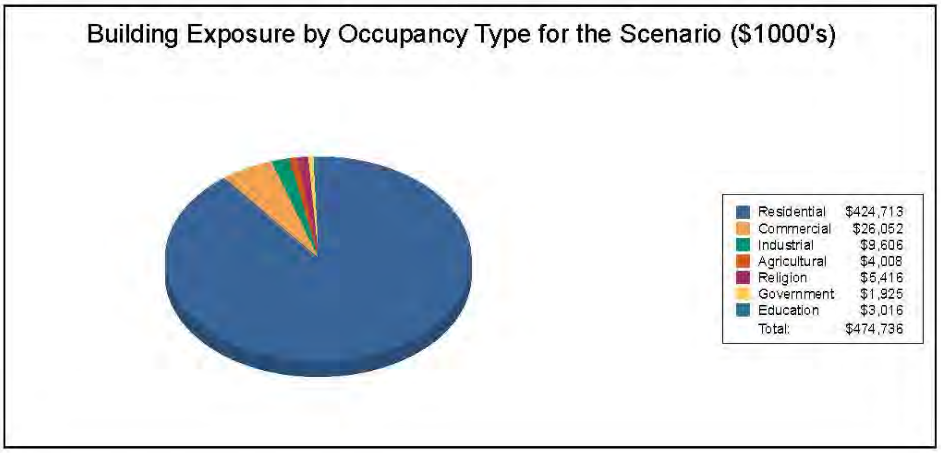


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	424,713	89.5%
Commercial	26,052	5.5%
Industrial	9,606	2.0%
Agricultural	4,008	0.8%
Religion	5,416	1.1%
Government	1,925	0.4%
Education	3,016	0.6%
Total	**474,736**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 8 schools, 5 fire stations, 2 police stations and no emergency operation centers.

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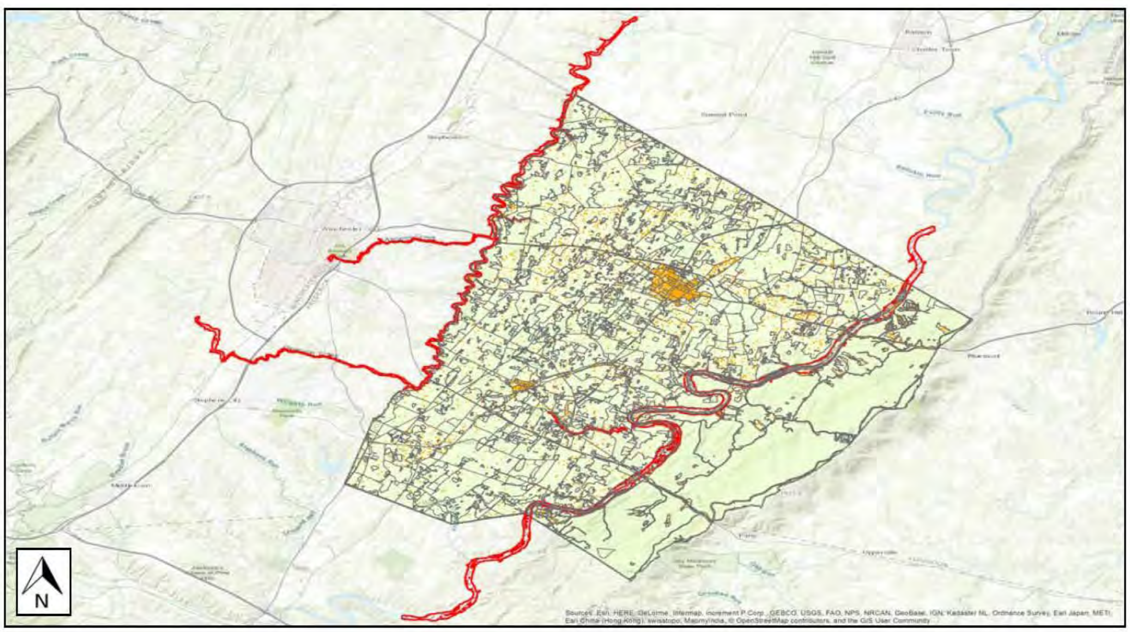
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Clarke
Scenario Name:	100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



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Building Damage

General Building Stock Damage

Hazus estimates that about 31 buildings will be at least moderately damaged. This is over 52% of the total number of buildings in the scenario. There are an estimated 7 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

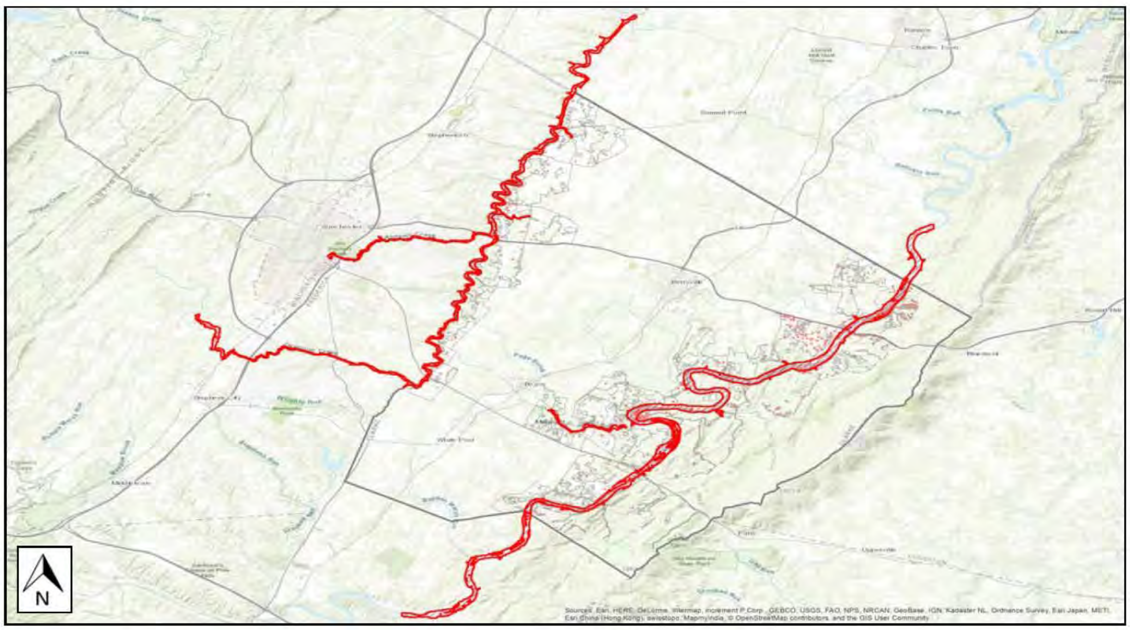

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Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	1	100	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	2	6	8	25	6	19	4	13	5	16	7	22
Total	**2**		**9**		**6**		**4**		**5**		**7**	

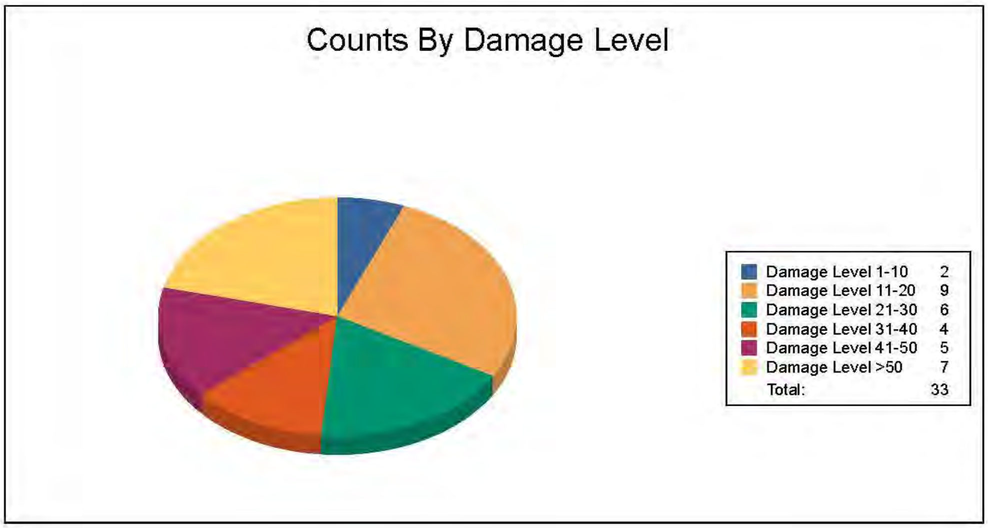

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Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	1	17	1	17	1	17	1	17	2	33
Steel	0	0	1	100	0	0	0	0	0	0	0	0
Wood	2	7	8	27	5	17	4	13	4	13	7	23

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Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	0	0	0	0
Fire Stations	5	0	0	0
Hospitals	0	0	0	0
Police Stations	2	0	0	0
Schools	8	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

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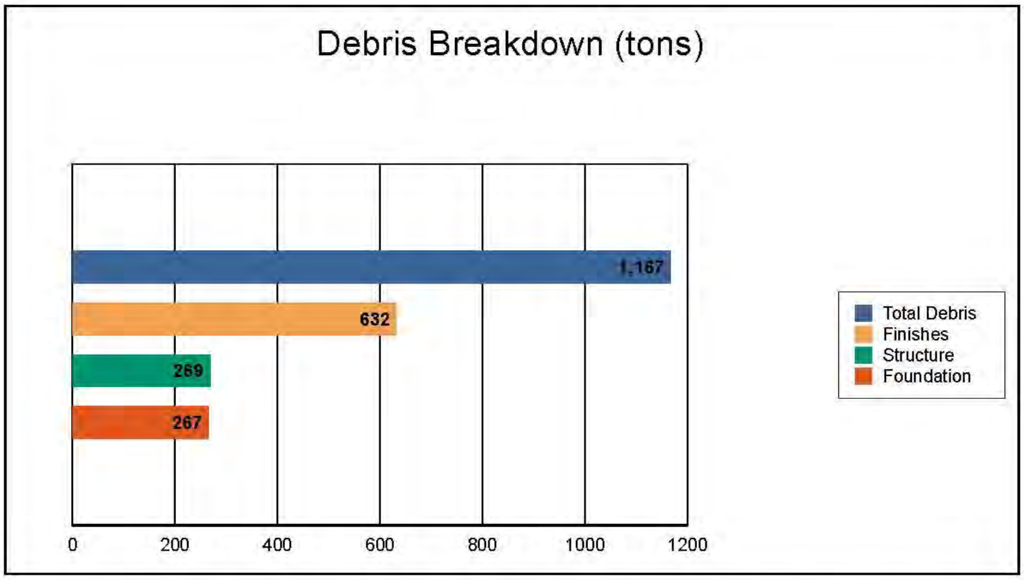
Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.



The model estimates that a total of 1,167 tons of debris will be generated. Of the total amount, Finishes comprises 54% of the total, Structure comprises 23% of the total, and Foundation comprises 23%. If the debris tonnage is converted into an estimated number of truckloads, it will require 47 truckloads (@25 tons/truck) to remove the debris generated by the flood.

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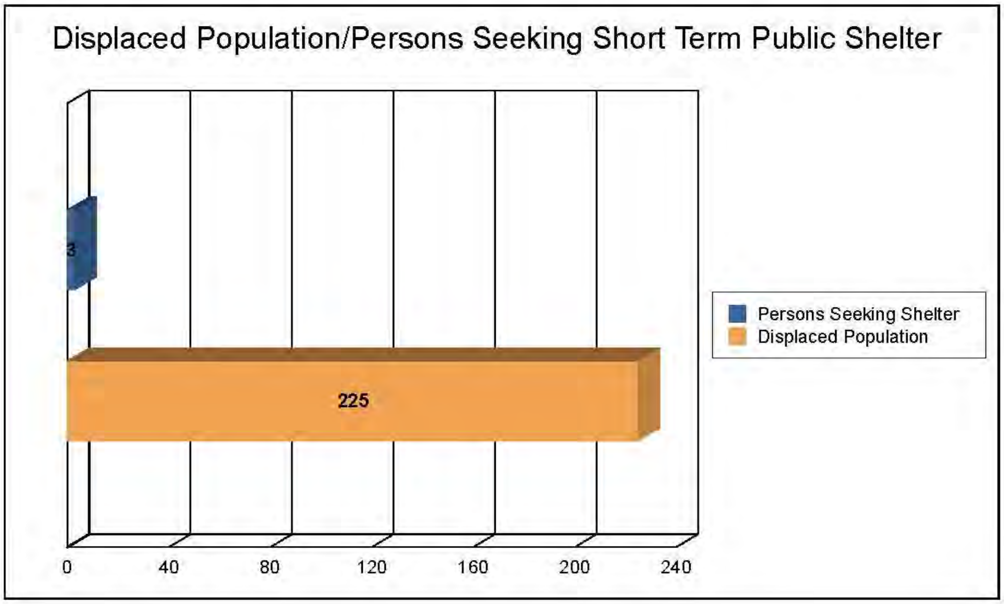
Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 75 households (or 225 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 3 people (out of a total population of 14,034) will seek temporary shelter in public shelters.



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Economic Loss

The total economic loss estimated for the flood is 29.29 million dollars, which represents 6.17 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 21.04 million dollars. 28% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 67.82% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

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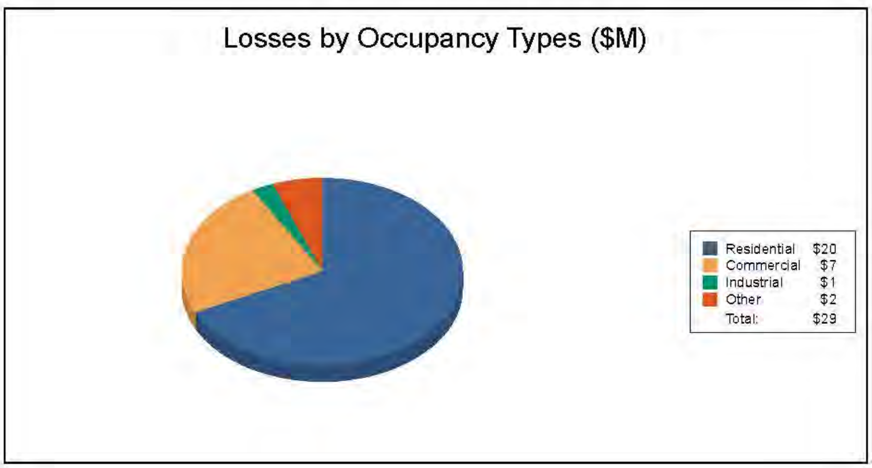
Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	11.37	0.77	0.21	0.05	12.39
	Content	5.78	2.06	0.44	0.29	8.57
	Inventory	0.00	0.02	0.06	0.00	0.08
	Subtotal	**17.15**	**2.85**	**0.70**	**0.34**	**21.04**
Business Interruption						
	Income	0.00	2.00	0.02	0.07	2.09
	Relocation	2.09	0.24	0.00	0.03	2.36
	Rental Income	0.62	0.19	0.00	0.01	0.83
	Wage	0.00	1.69	0.02	1.25	2.97
	Subtotal	**2.71**	**4.13**	**0.04**	**1.36**	**8.25**
ALL	**Total**	**19.86**	**6.98**	**0.74**	**1.71**	**29.29**



Appendix A: County Listing for the Region

Virginia

- Clarke

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Virginia				
Clarke	14,034	1,859,838	346,774	2,206,612
Total	**14,034**	**1,859,838**	**346,774**	**2,206,612**
Total Study Region	**14,034**	**1,859,838**	**346,774**	**2,206,612**

Frederick County:

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Hazus-MH: Flood Global Risk Report

Region Name: Frederick

Flood Scenario: 100

Print Date: Monday, February 05, 2018

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Virginia

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is approximately 416 square miles and contains 3,116 census blocks. The region contains over 29 thousand households and has a total population of 78,305 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 31,745 buildings in the region with a total building replacement value (excluding contents) of 9,055 million dollars. Approximately 93.70% of the buildings (and 84.71% of the building value) are associated with residential housing.

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Building Inventory

General Building Stock

Hazus estimates that there are 31,745 buildings in the region which have an aggregate total replacement value of 9,055 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	7,670,537	84.7%
Commercial	734,620	8.1%
Industrial	410,155	4.5%
Agricultural	42,606	0.5%
Religion	87,809	1.0%
Government	31,788	0.4%
Education	77,101	0.9%
Total	**9,054,616**	**100%**

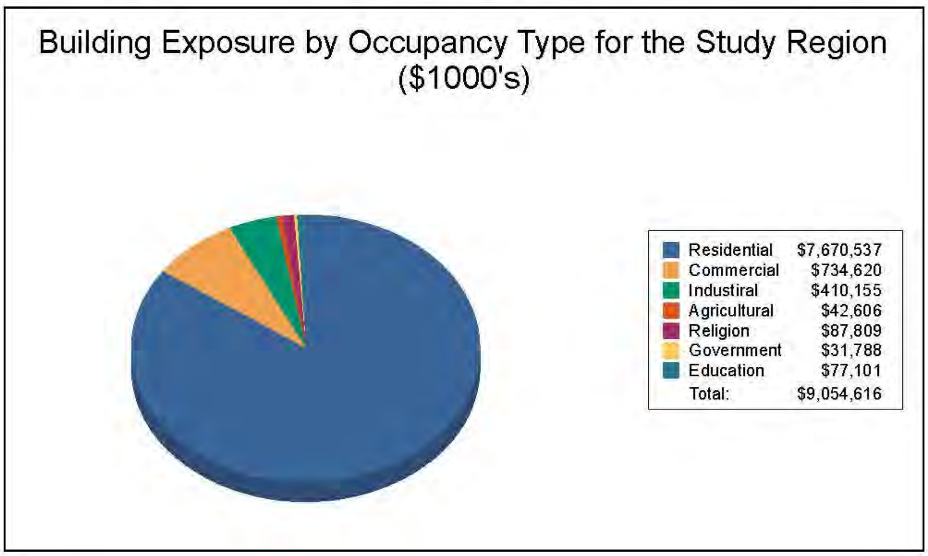
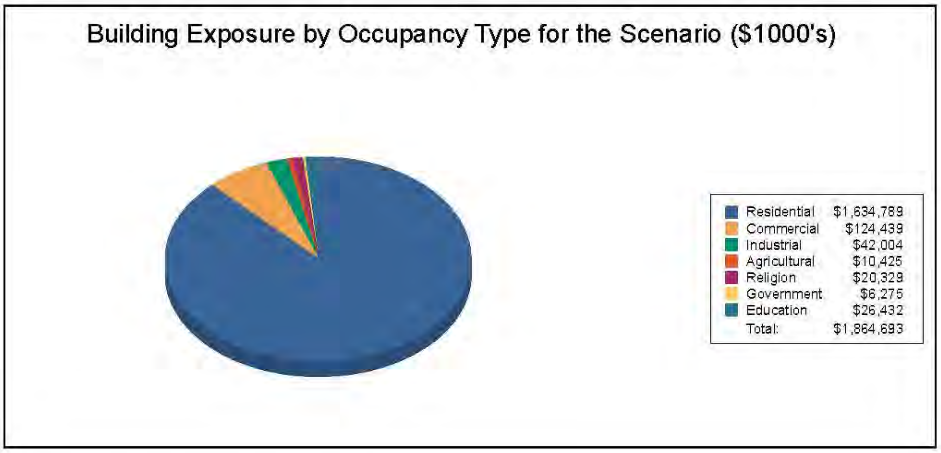


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,634,789	87.7%
Commercial	124,439	6.7%
Industrial	42,004	2.3%
Agricultural	10,425	0.6%
Religion	20,329	1.1%
Government	6,275	0.3%
Education	26,432	1.4%
Total	**1,864,693**	**100%**



Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 392 beds. There are 22 schools, 19 fire stations, 1 police station and no emergency operation centers.

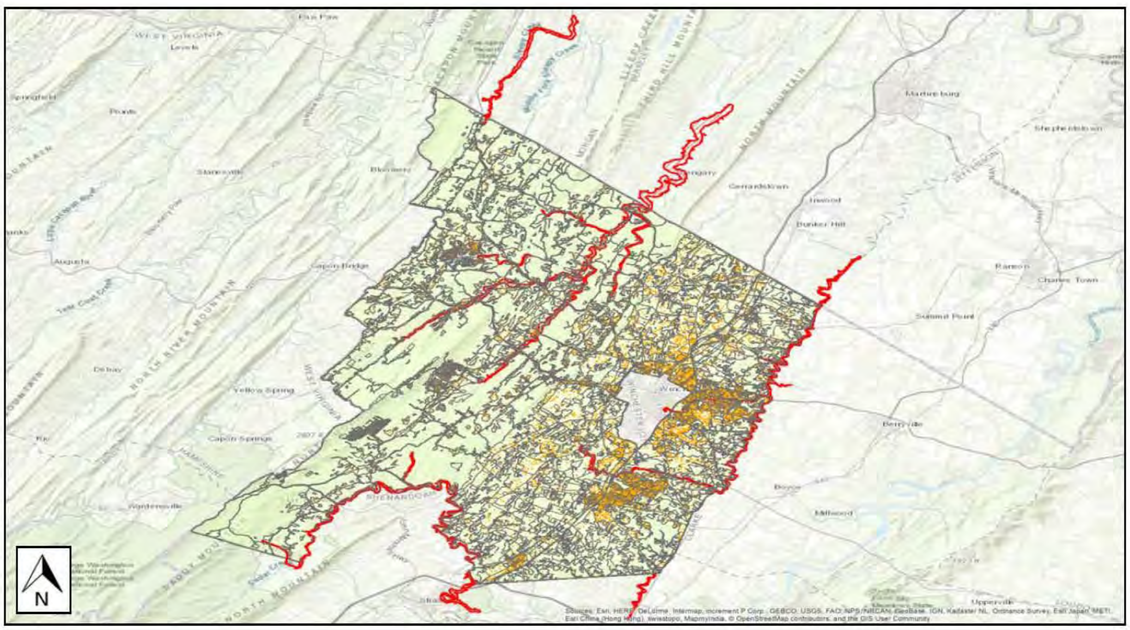
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Frederick
Scenario Name:	100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



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Building Damage

General Building Stock Damage

Hazus estimates that about 31 buildings will be at least moderately damaged. This is over 47% of the total number of buildings in the scenario. There are an estimated 10 buildings that will be completely destroyed. The definition of the ‘damage states’ is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

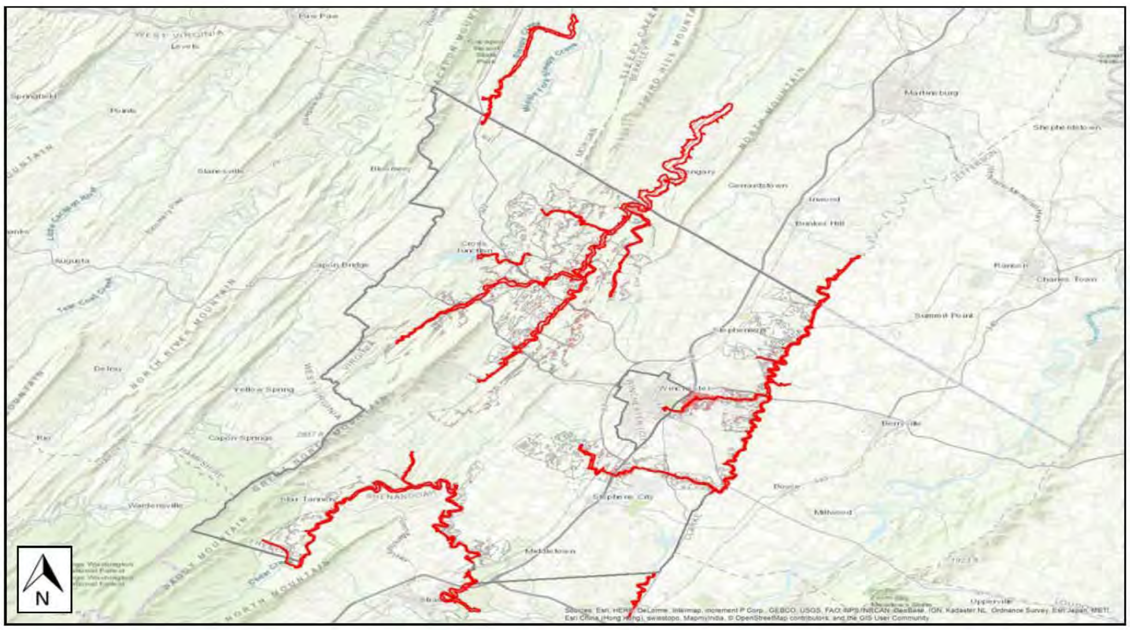

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	2	6	9	27	5	15	3	9	4	12	10	30
Total	**2**		**9**		**5**		**3**		**4**		**10**	

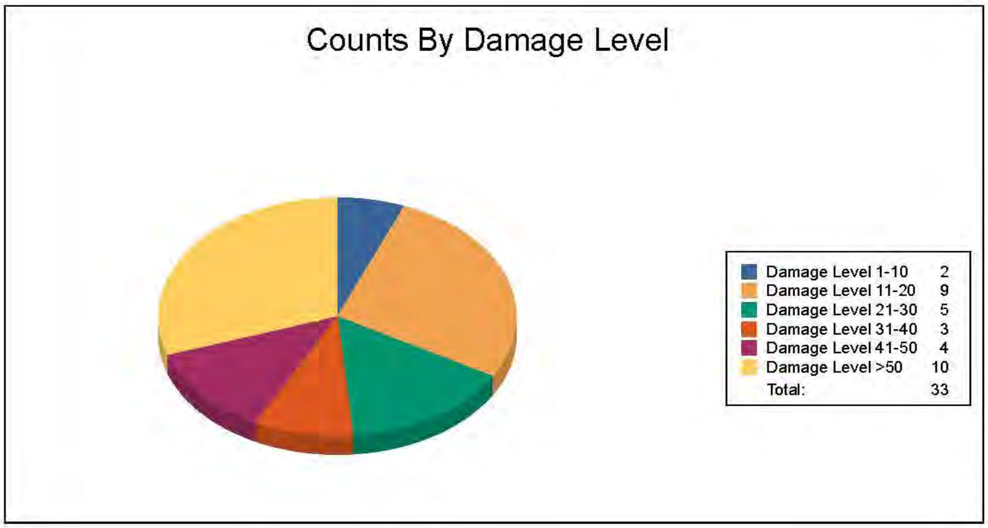

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Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	0	0	2	100	0	0	0	0	0	0	0	0
Steel	0	0	0	0	0	0	0	0	0	0	0	0
Wood	2	6	9	27	5	15	3	9	4	12	10	30

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Essential Facility Damage

Before the flood analyzed in this scenario, the region had 392 hospital beds available for use. On the day of the scenario flood event, the model estimates that 392 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	0	0	0	0
Fire Stations	19	0	0	0
Hospitals	1	0	0	0
Police Stations	1	0	0	0
Schools	22	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

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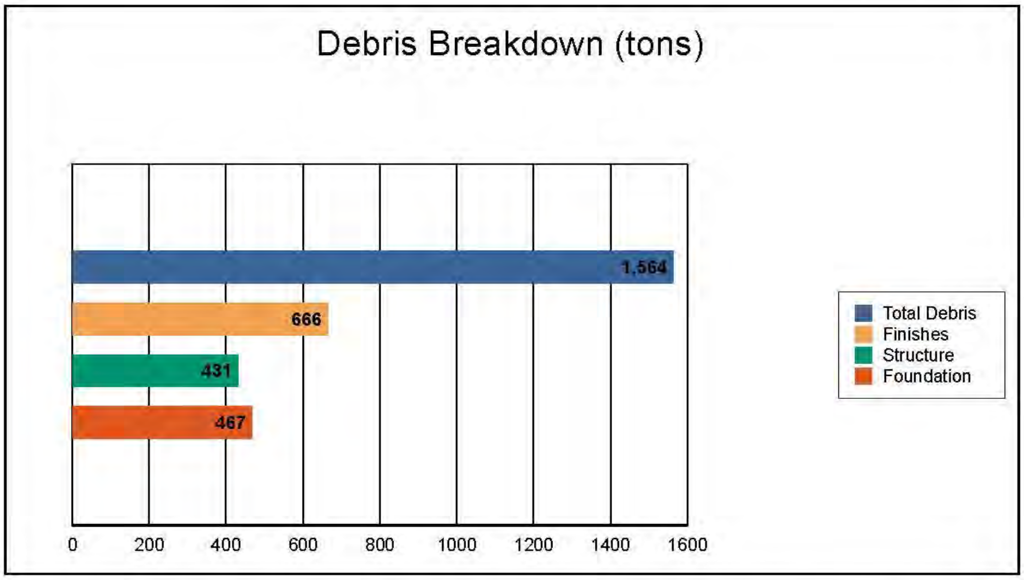
Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.



The model estimates that a total of 1,564 tons of debris will be generated. Of the total amount, Finishes comprises 43% of the total, Structure comprises 28% of the total, and Foundation comprises 30%. If the debris tonnage is converted into an estimated number of truckloads, it will require 63 truckloads (@25 tons/truck) to remove the debris generated by the flood.

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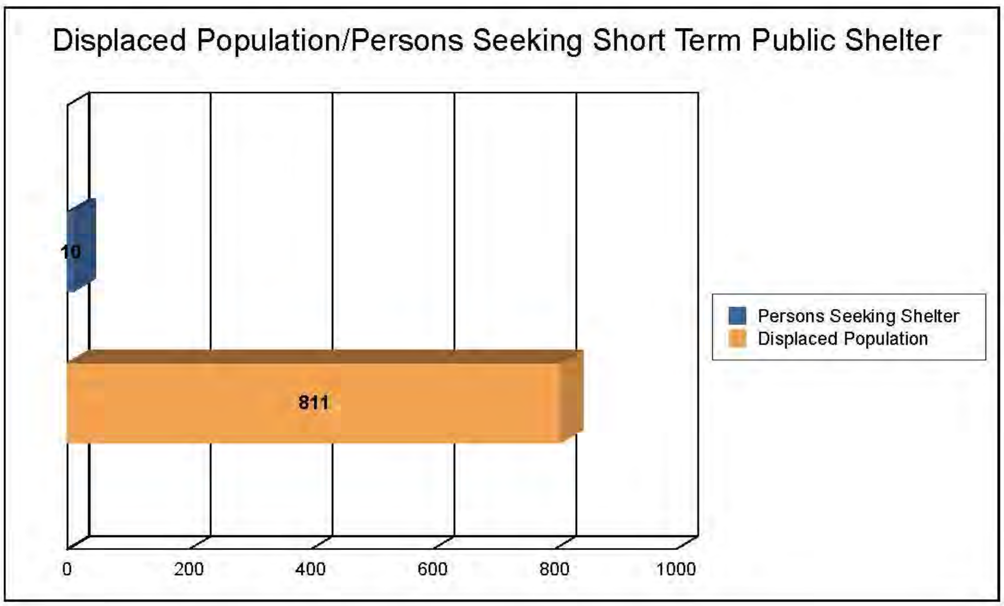
Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 270 households (or 811 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 10 people (out of a total population of 78,305) will seek temporary shelter in public shelters.



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Economic Loss

The total economic loss estimated for the flood is 70.36 million dollars, which represents 3.77 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 53.85 million dollars. 23% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 73.21% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

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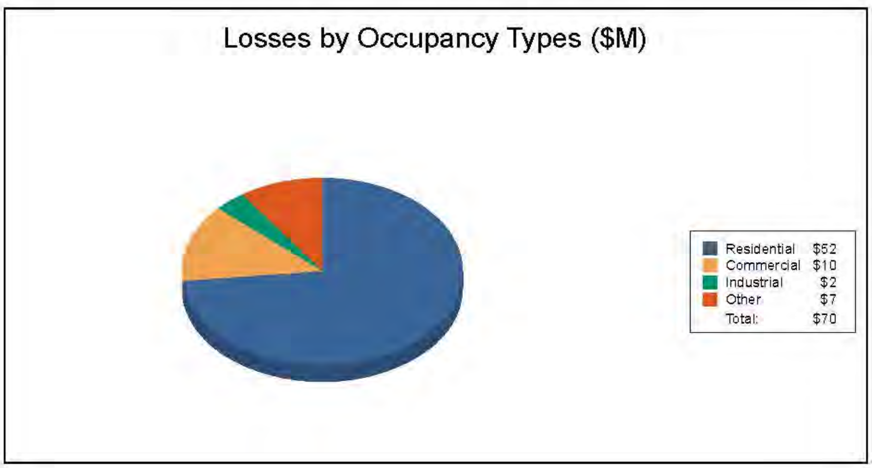
Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	29.43	1.49	0.76	0.40	32.07
	Content	14.93	3.40	1.43	1.78	21.54
	Inventory	0.00	0.05	0.17	0.01	0.24
	Subtotal	**44.36**	**4.94**	**2.36**	**2.19**	**53.85**
Business Interruption						
	Income	0.04	2.17	0.03	0.67	2.91
	Relocation	5.32	0.25	0.01	0.07	5.65
	Rental Income	1.68	0.19	0.00	0.00	1.87
	Wage	0.11	2.00	0.05	3.92	6.08
	Subtotal	**7.15**	**4.61**	**0.09**	**4.65**	**16.51**
ALL	**Total**	**51.51**	**9.55**	**2.46**	**6.85**	**70.36**



Appendix A: County Listing for the Region

Virginia
- Frederick

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Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Virginia				
Frederick	78,305	7,670,537	1,384,079	9,054,616
Total	**78,305**	**7,670,537**	**1,384,079**	**9,054,616**
Total Study Region	**78,305**	**7,670,537**	**1,384,079**	**9,054,616**

Page County:

Hazus-MH: Flood Global Risk Report

Region Name:	Page
Flood Scenario:	100
Print Date:	Tuesday, February 06, 2018

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Virginia

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is approximately 314 square miles and contains 1,793 census blocks. The region contains over 10 thousand households and has a total population of 24,042 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 11,974 buildings in the region with a total building replacement value (excluding contents) of 2,533 million dollars. Approximately 92.56% of the buildings (and 81.93% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 11,974 buildings in the region which have an aggregate total replacement value of 2,533 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,075,285	81.9%
Commercial	234,254	9.2%
Industrial	120,845	4.8%
Agricultural	20,902	0.8%
Religion	45,997	1.8%
Government	16,174	0.6%
Education	19,473	0.8%
Total	**2,532,930**	**100%**

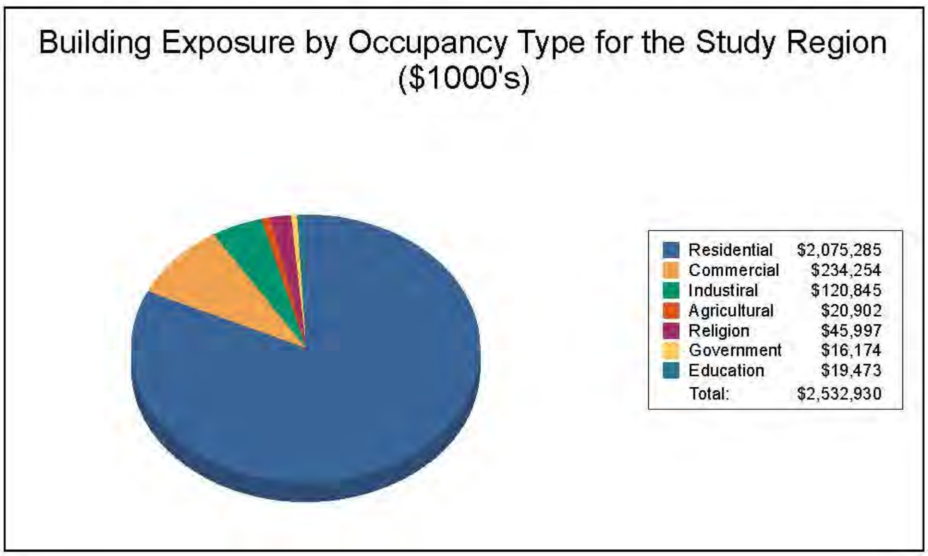

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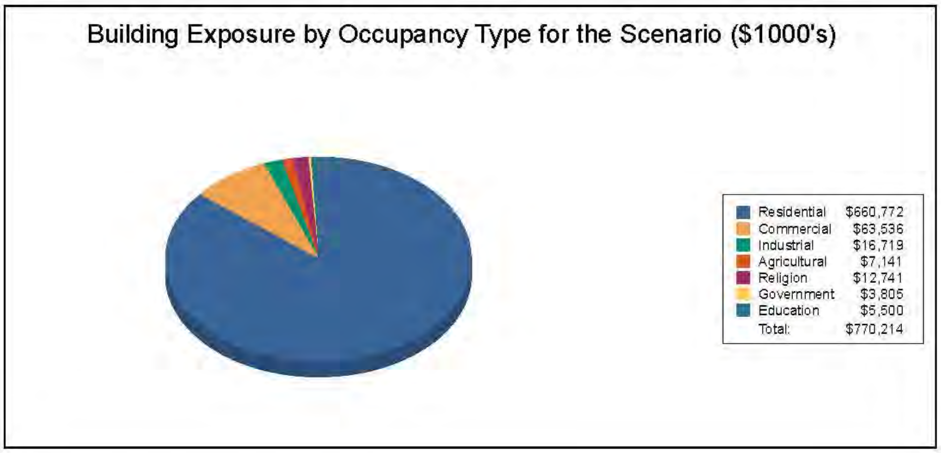
Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	660,772	85.8%
Commercial	63,536	8.2%
Industrial	16,719	2.2%
Agricultural	7,141	0.9%
Religion	12,741	1.7%
Government	3,805	0.5%
Education	5,500	0.7%
Total	**770,214**	**100%**



Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 17 beds. There are 10 schools, 2 fire stations, 5 police stations and no emergency operation centers.

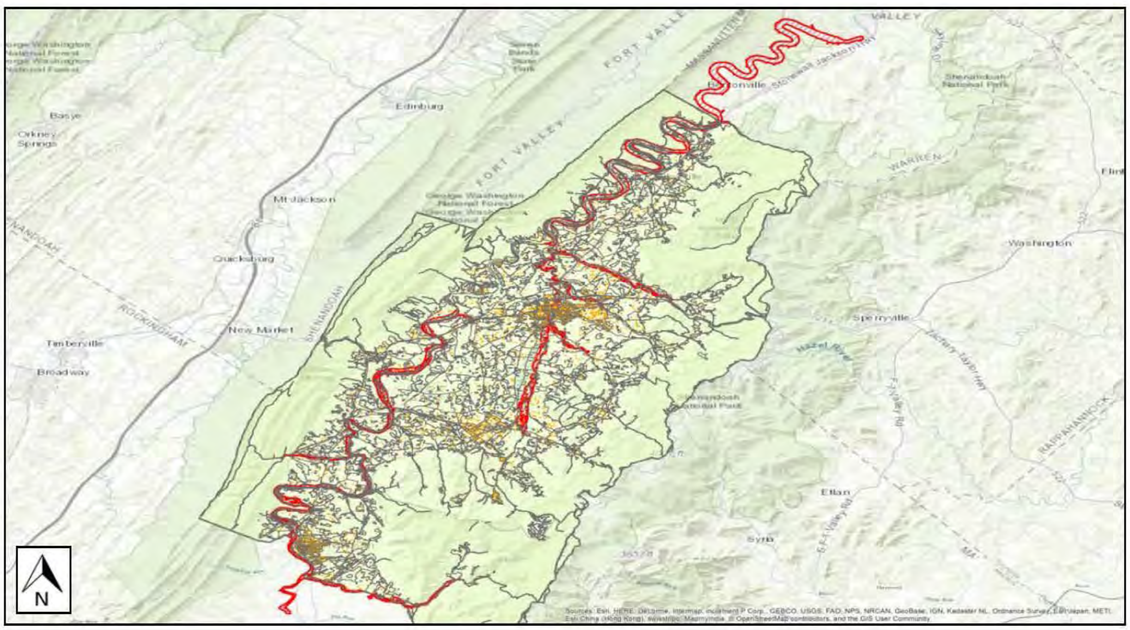
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Page
Scenario Name:	100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



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Building Damage

General Building Stock Damage

Hazus estimates that about 43 buildings will be at least moderately damaged. This is over 44% of the total number of buildings in the scenario. There are an estimated 23 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

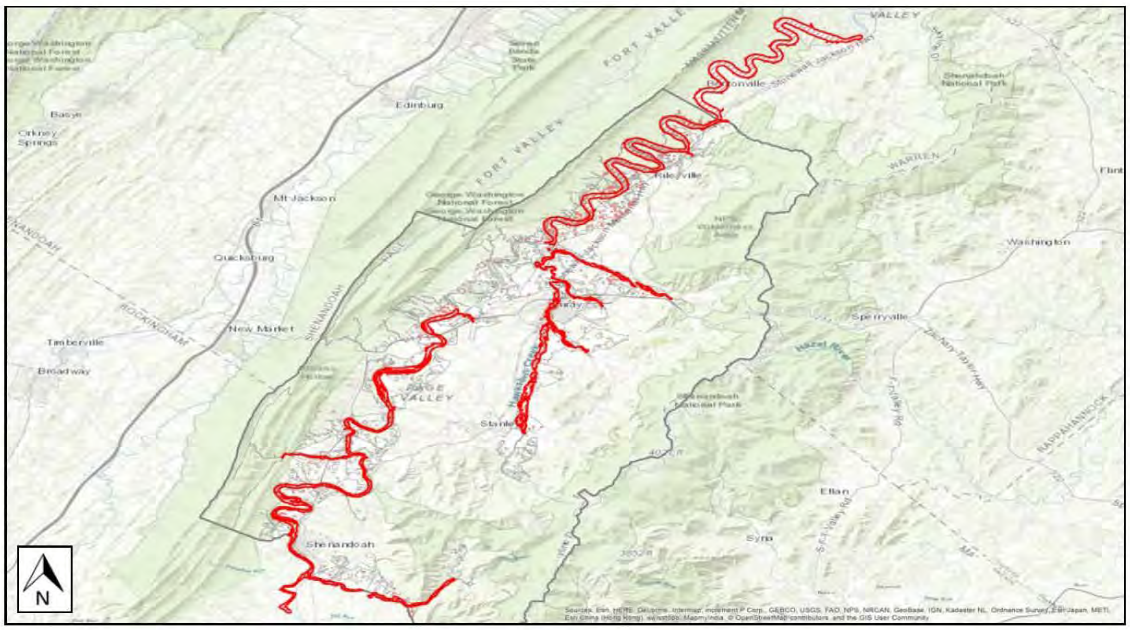

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Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	9	17	13	25	3	6	3	6	1	2	23	44
Total	**9**		**13**		**3**		**3**		**1**		**23**	

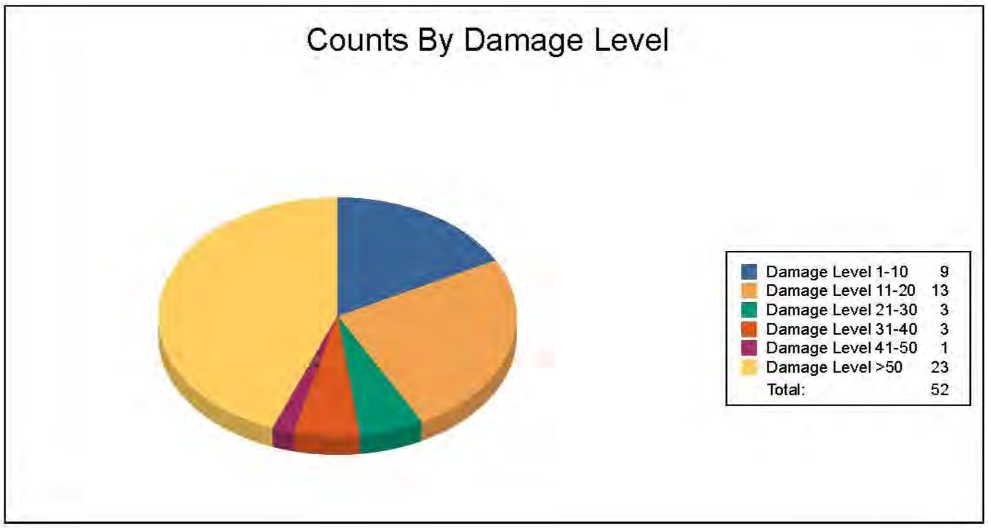

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	3	100
Masonry	3	30	3	30	0	0	0	0	0	0	4	40
Steel	0	0	0	0	0	0	0	0	0	0	0	0
Wood	9	20	11	24	3	7	3	7	1	2	18	40

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 17 hospital beds available for use. On the day of the scenario flood event, the model estimates that 17 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	0	0	0	0
Fire Stations	2	0	0	0
Hospitals	1	0	0	0
Police Stations	5	0	0	0
Schools	10	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

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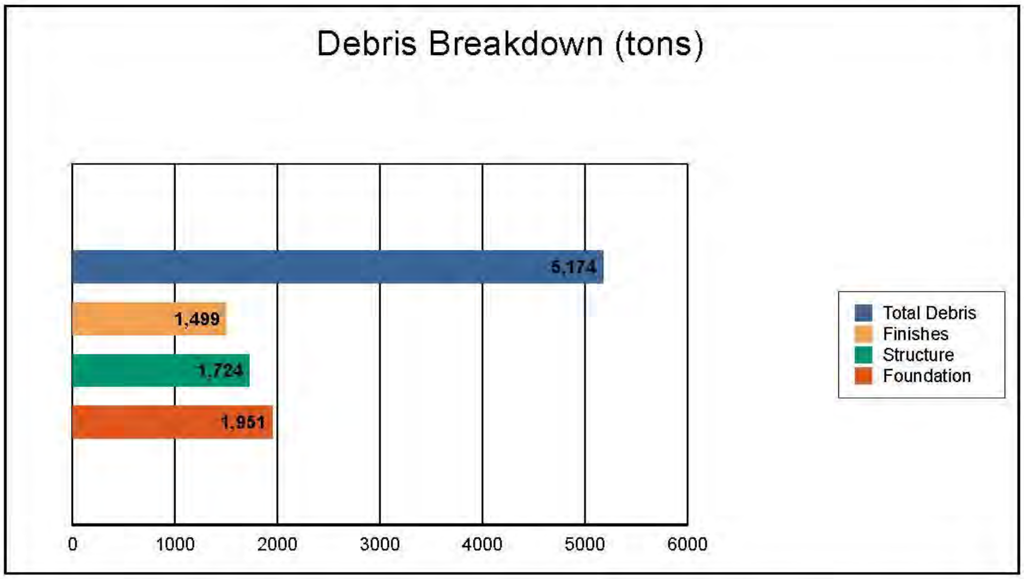
Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.



The model estimates that a total of 5,174 tons of debris will be generated. Of the total amount, Finishes comprises 29% of the total, Structure comprises 33% of the total, and Foundation comprises 38%. If the debris tonnage is converted into an estimated number of truckloads, it will require 207 truckloads (@25 tons/truck) to remove the debris generated by the flood.

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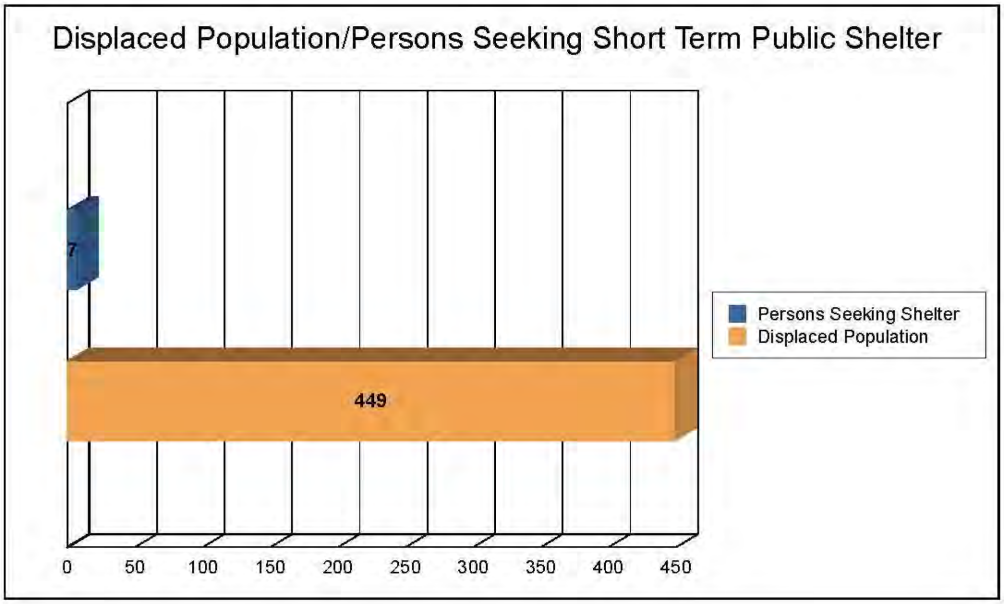
Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 150 households (or 449 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 7 people (out of a total population of 24,042) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 58.69 million dollars, which represents 7.62 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 35.32 million dollars. 40% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 58.44% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

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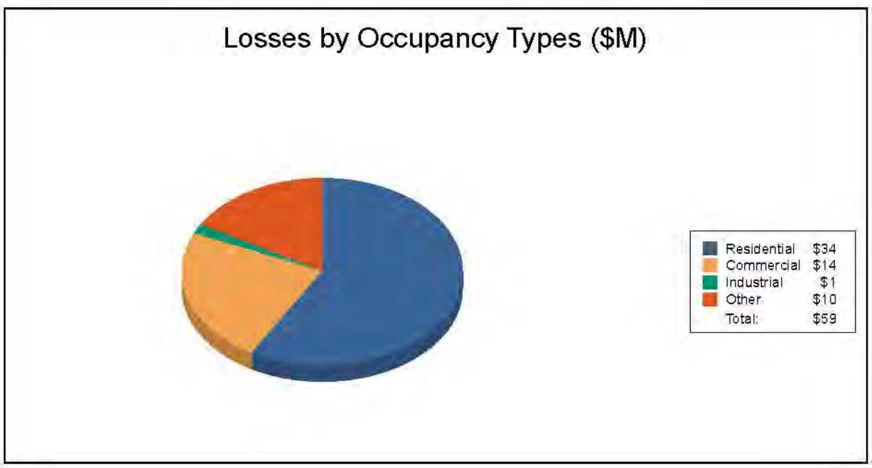
Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	18.17	1.51	0.26	0.42	20.36
	Content	9.19	3.74	0.51	1.38	14.83
	Inventory	0.00	0.04	0.10	0.01	0.14
	Subtotal	**27.36**	**5.29**	**0.86**	**1.81**	**35.32**
Business Interruption						
	Income	0.48	4.09	0.02	0.62	5.22
	Relocation	3.69	0.52	0.02	0.22	4.46
	Rental Income	1.61	0.36	0.01	0.03	2.01
	Wage	1.15	3.37	0.03	7.14	11.69
	Subtotal	**6.94**	**8.34**	**0.08**	**8.01**	**23.37**
ALL	**Total**	**34.30**	**13.63**	**0.94**	**9.82**	**58.69**



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Appendix A: County Listing for the Region

Virginia
- Page

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Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Virginia				
Page	24,042	2,075,285	457,645	2,532,930
Total	**24,042**	**2,075,285**	**457,645**	**2,532,930**
Total Study Region	**24,042**	**2,075,285**	**457,645**	**2,532,930**

Shenandoah County:

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Hazus-MH: Flood Global Risk Report

Region Name: Shenandoah

Flood Scenario: 100

Print Date: Wednesday, February 07, 2018

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Virginia

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is approximately 512 square miles and contains 2,084 census blocks. The region contains over 17 thousand households and has a total population of 41,993 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 20,341 buildings in the region with a total building replacement value (excluding contents) of 6,213 million dollars. Approximately 91.62% of the buildings (and 72.74% of the building value) are associated with residential housing.

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Building Inventory

General Building Stock

Hazus estimates that there are 20,341 buildings in the region which have an aggregate total replacement value of 6,213 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	4,519,659	72.7%
Commercial	565,249	9.1%
Industrial	838,621	13.5%
Agricultural	33,183	0.5%
Religion	99,533	1.6%
Government	60,560	1.0%
Education	96,306	1.6%
Total	**6,213,111**	**100%**

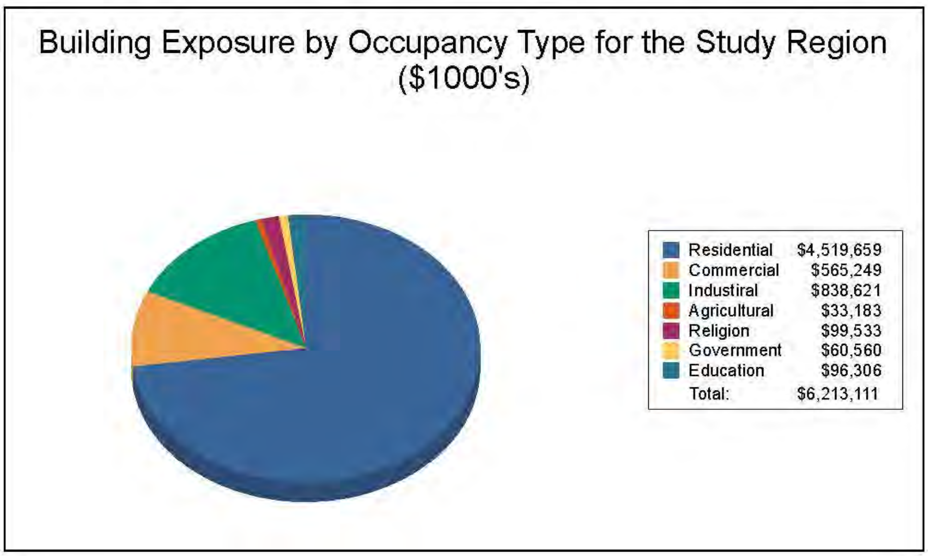
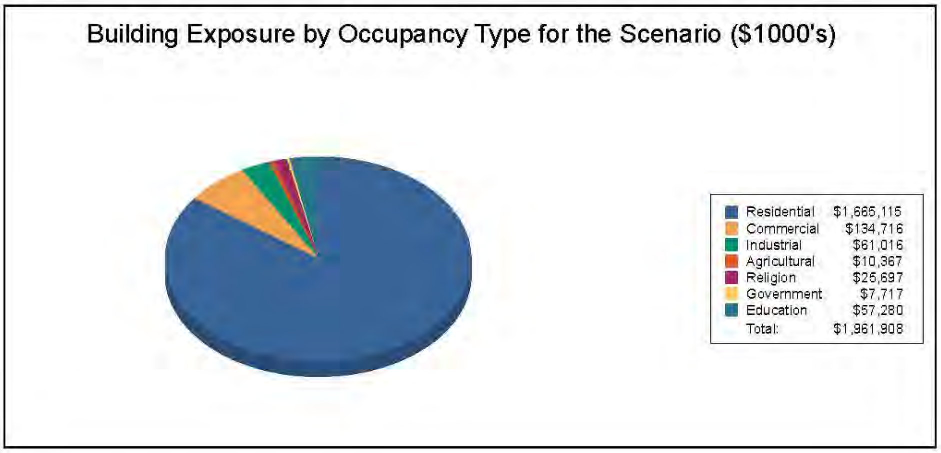


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,665,115	84.9%
Commercial	134,716	6.9%
Industrial	61,016	3.1%
Agricultural	10,367	0.5%
Religion	25,697	1.3%
Government	7,717	0.4%
Education	57,280	2.9%
Total	**1,961,908**	**100%**



Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 15 schools, 15 fire stations, 6 police stations and no emergency operation centers.

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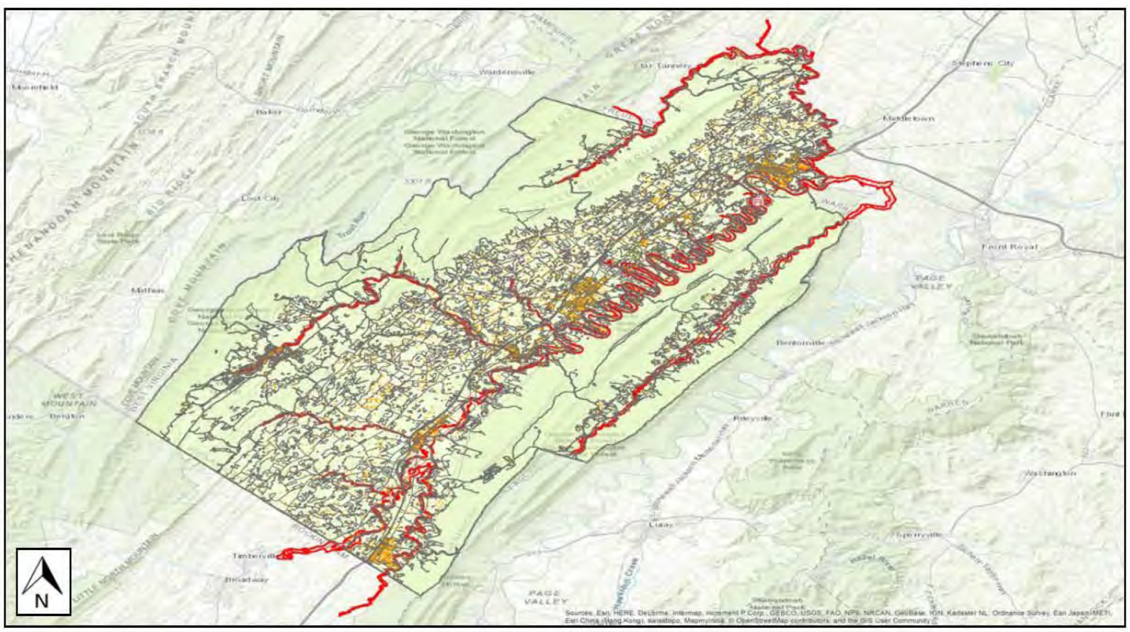
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Shenandoah
Scenario Name:	100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 374 buildings will be at least moderately damaged. This is over 10% of the total number of buildings in the scenario. There are an estimated 287 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

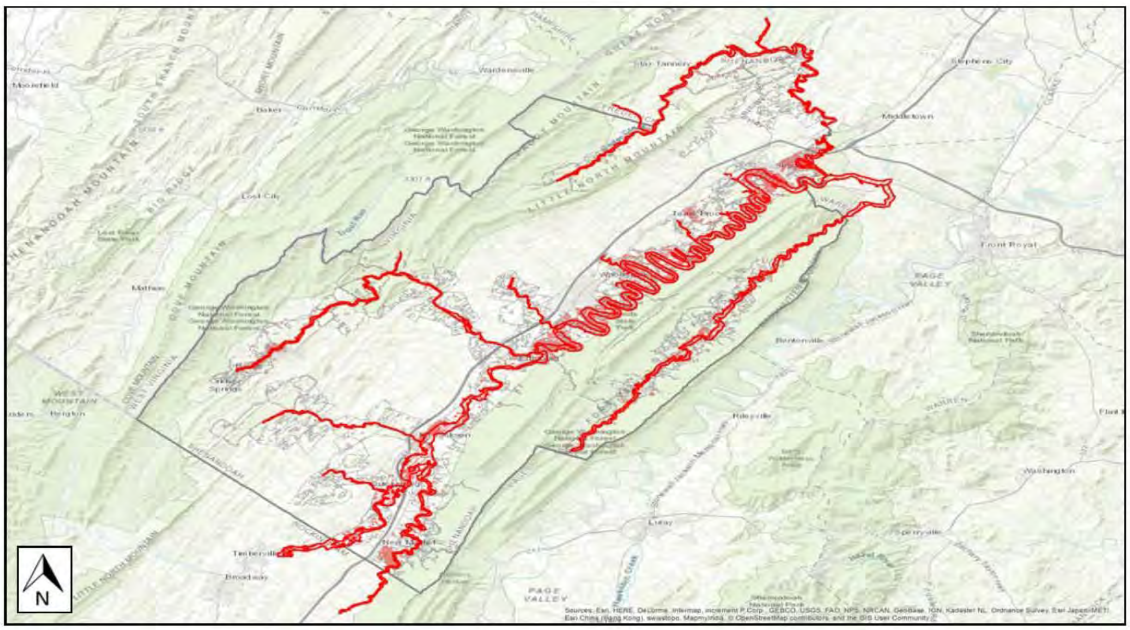


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Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	3	1	17	5	16	4	20	5	34	9	287	76
Total	**3**		**17**		**16**		**20**		**34**		**287**	

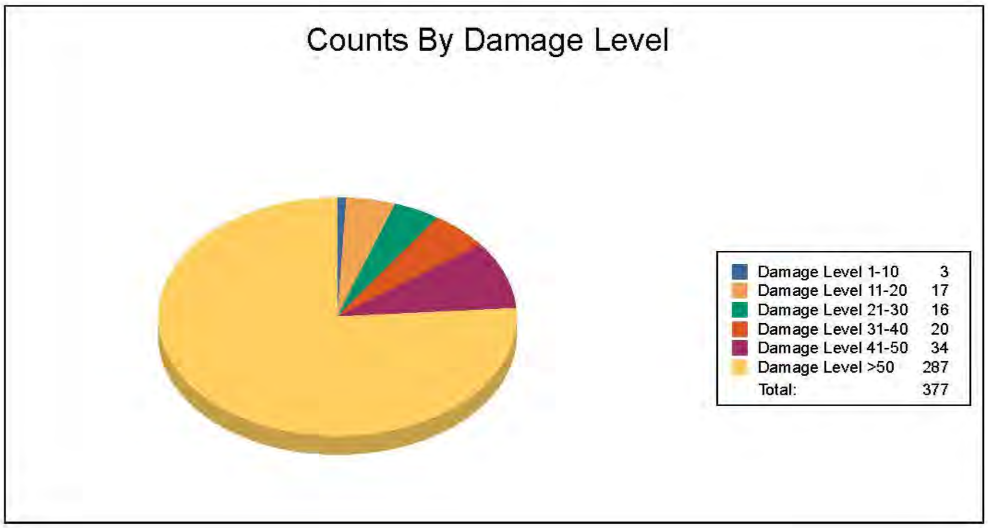

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Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	1	100
Masonry	0	0	4	5	3	3	5	6	7	8	69	78
Steel	0	0	0	0	0	0	0	0	0	0	0	0
Wood	3	1	16	5	15	5	18	6	30	10	231	74

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Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	0	0	0	0
Fire Stations	15	0	0	0
Hospitals	0	0	0	0
Police Stations	6	0	0	0
Schools	15	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

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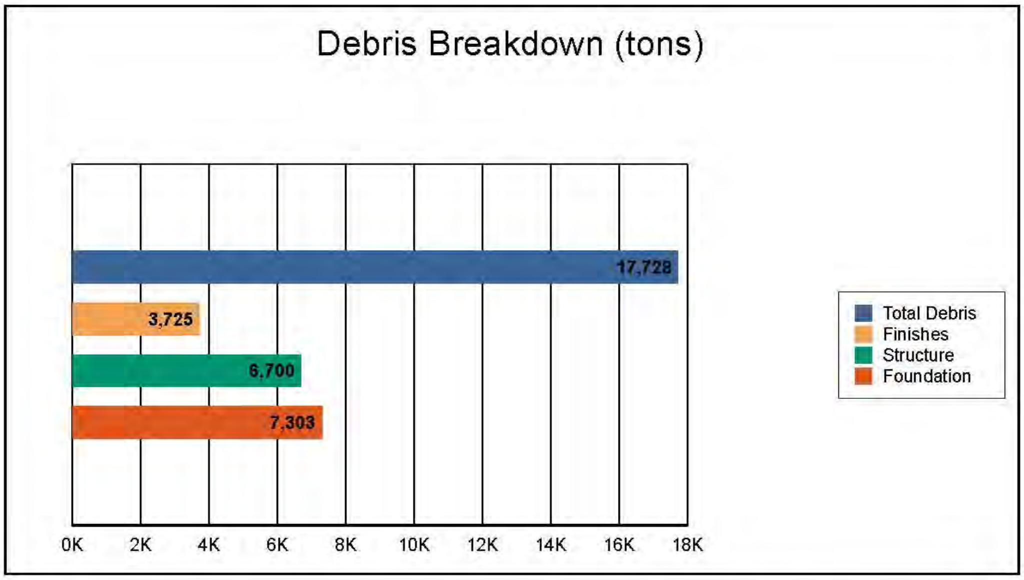
Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.



The model estimates that a total of 17,728 tons of debris will be generated. Of the total amount, Finishes comprises 21% of the total, Structure comprises 38% of the total, and Foundation comprises 41%. If the debris tonnage is converted into an estimated number of truckloads, it will require 710 truckloads (@25 tons/truck) to remove the debris generated by the flood.

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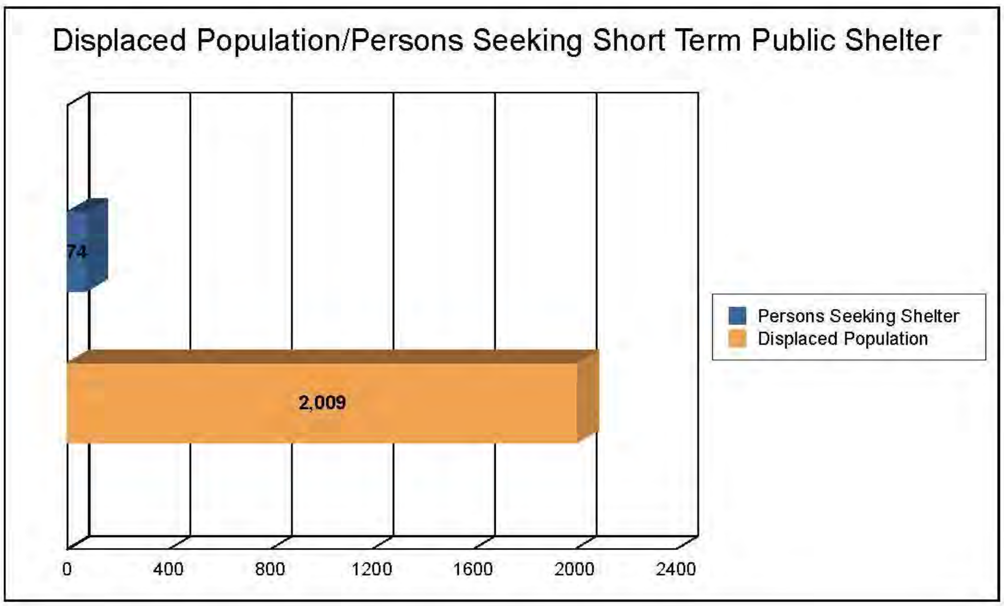
Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 670 households (or 2,009 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 74 people (out of a total population of 41,993) will seek temporary shelter in public shelters.



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Economic Loss

The total economic loss estimated for the flood is 352.73 million dollars, which represents 17.98 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 265.76 million dollars. 25% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 66.53% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

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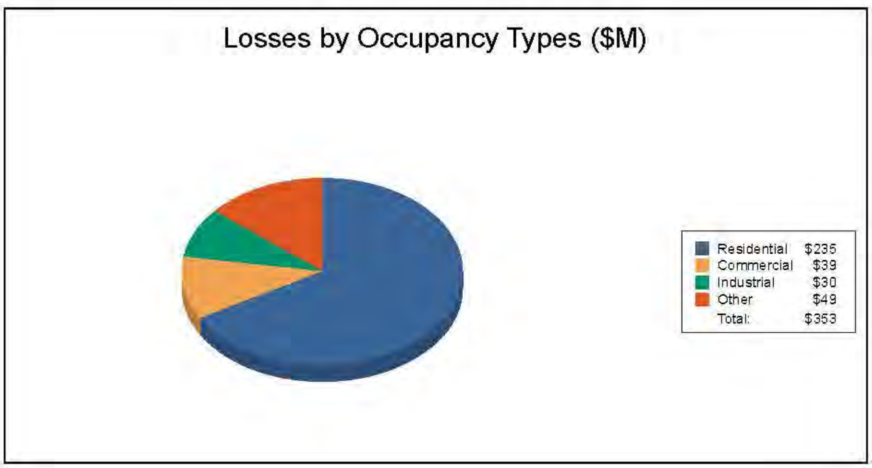
Table 6: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	137.07	6.93	9.00	3.98	156.98
	Content	66.68	12.95	18.00	8.72	106.35
	Inventory	0.00	0.27	2.06	0.09	2.43
	Subtotal	**203.74**	**20.16**	**29.07**	**12.78**	**265.76**
Business Interruption						
	Income	0.97	8.57	0.17	3.47	13.18
	Relocation	20.40	0.96	0.28	1.31	22.95
	Rental Income	7.28	0.72	0.05	0.08	8.13
	Wage	2.29	8.72	0.33	31.39	42.72
	Subtotal	**30.94**	**18.96**	**0.83**	**36.24**	**86.97**
ALL	**Total**	**234.69**	**39.12**	**29.90**	**49.03**	**352.73**



Appendix A: County Listing for the Region

Virginia

- Shenandoah

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Virginia				
Shenandoah	41,993	4,519,659	1,693,452	6,213,111
Total	**41,993**	**4,519,659**	**1,693,452**	**6,213,111**
Total Study Region	**41,993**	**4,519,659**	**1,693,452**	**6,213,111**

Warren County:

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Hazus-MH: Flood Global Risk Report

Region Name: Warren

Flood Scenario: 100

Print Date: Tuesday, February 06, 2018

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Virginia

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is approximately 217 square miles and contains 1,987 census blocks. The region contains over 14 thousand households and has a total population of 37,575 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 15,905 buildings in the region with a total building replacement value (excluding contents) of 4,806 million dollars. Approximately 91.85% of the buildings (and 83.85% of the building value) are associated with residential housing.

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Building Inventory

General Building Stock

Hazus estimates that there are 15,905 buildings in the region which have an aggregate total replacement value of 4,806 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	4,029,791	83.9%
Commercial	438,691	9.1%
Industrial	154,179	3.2%
Agricultural	9,333	0.2%
Religion	82,356	1.7%
Government	27,162	0.6%
Education	64,343	1.3%
Total	**4,805,855**	**100%**

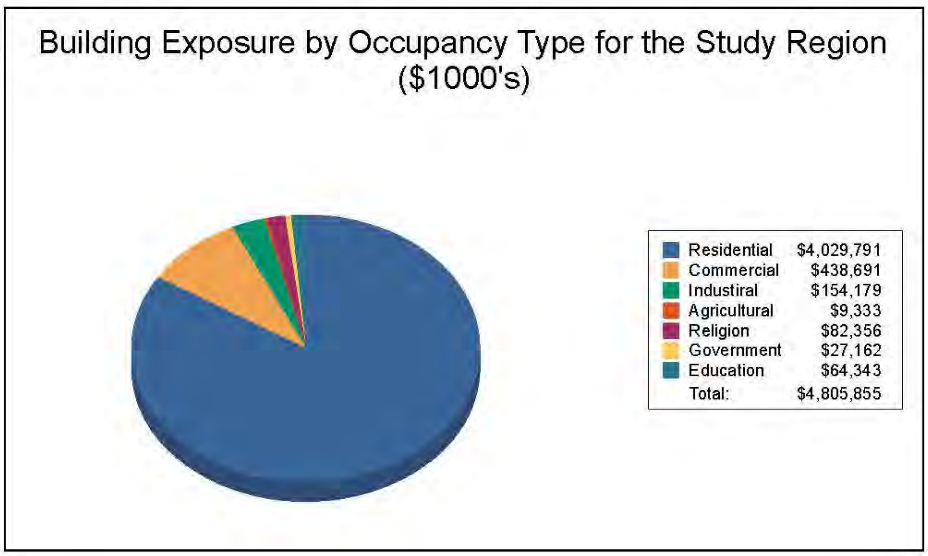
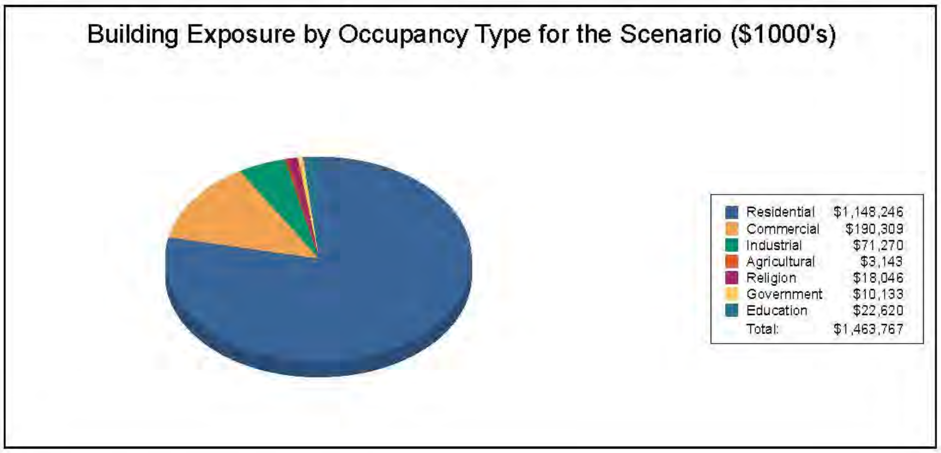


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,148,246	78.4%
Commercial	190,309	13.0%
Industrial	71,270	4.9%
Agricultural	3,143	0.2%
Religion	18,046	1.2%
Government	10,133	0.7%
Education	22,620	1.5%
Total	**1,463,767**	**100%**



Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 98 beds. There are 13 schools, 5 fire stations, 2 police stations and no emergency operation centers.

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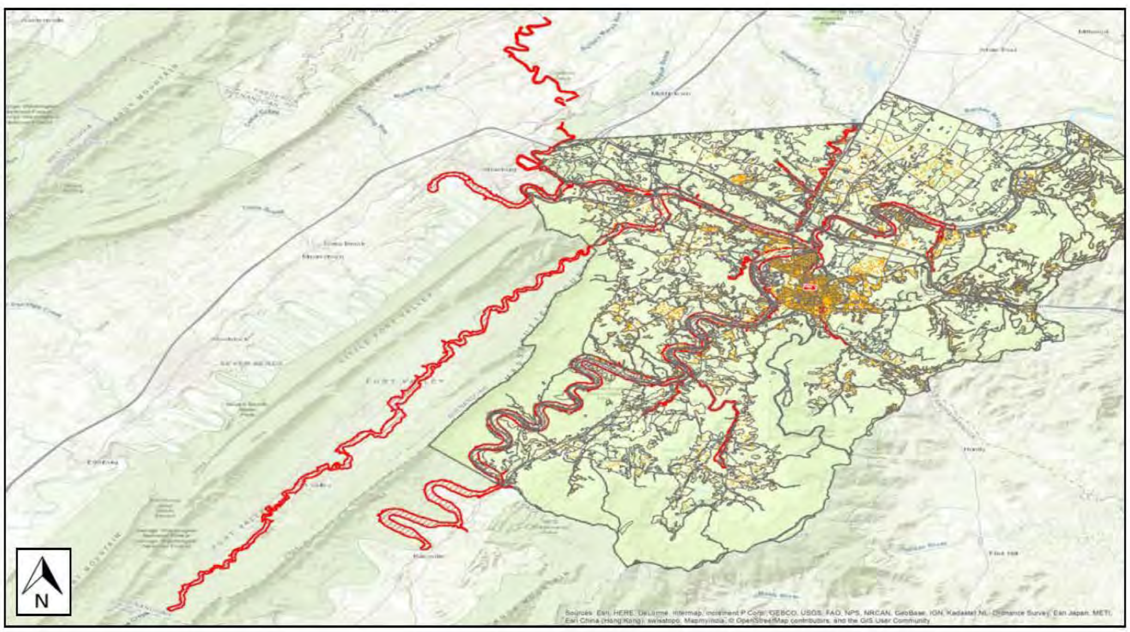
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Warren
Scenario Name:	100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



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Building Damage

General Building Stock Damage

Hazus estimates that about 172 buildings will be at least moderately damaged. This is over 49% of the total number of buildings in the scenario. There are an estimated 65 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

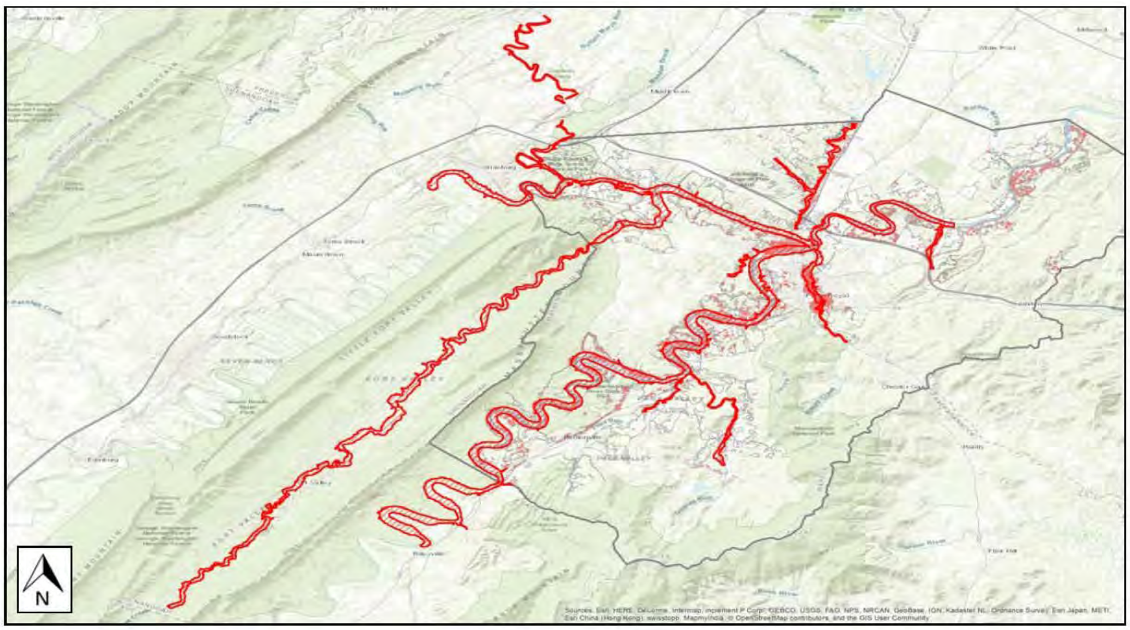

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Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	2	40	3	60	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	2	100	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	1	100
Religion	0	0	1	100	0	0	0	0	0	0	0	0
Residential	18	10	51	28	22	12	19	10	11	6	64	35
Total	**22**		**55**		**22**		**19**		**11**		**65**	

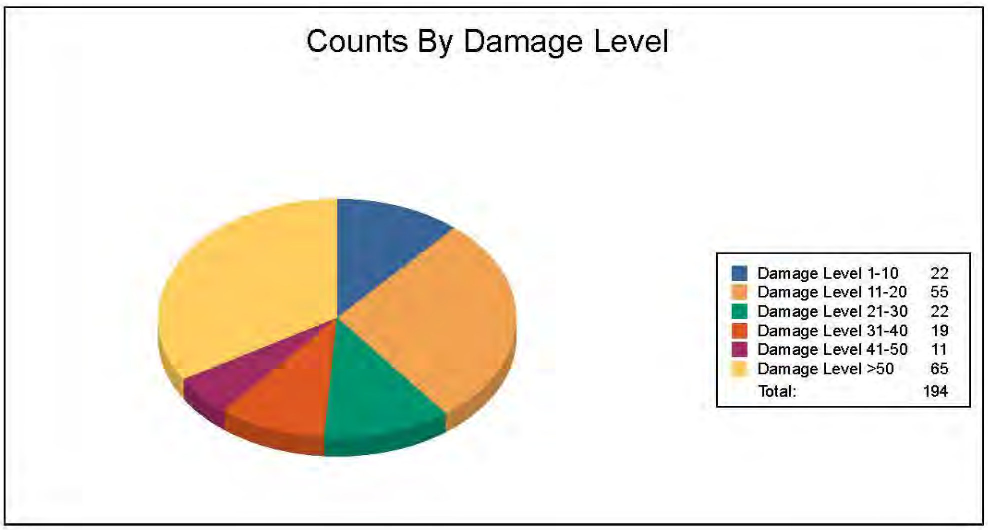

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	5	11	13	30	5	11	3	7	2	5	16	36
Steel	3	43	3	43	0	0	0	0	0	0	1	14
Wood	16	10	42	26	19	12	17	10	11	7	57	35

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Essential Facility Damage

Before the flood analyzed in this scenario, the region had 98 hospital beds available for use. On the day of the scenario flood event, the model estimates that 98 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	0	0	0	0
Fire Stations	5	2	0	2
Hospitals	1	0	0	0
Police Stations	2	0	0	0
Schools	13	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

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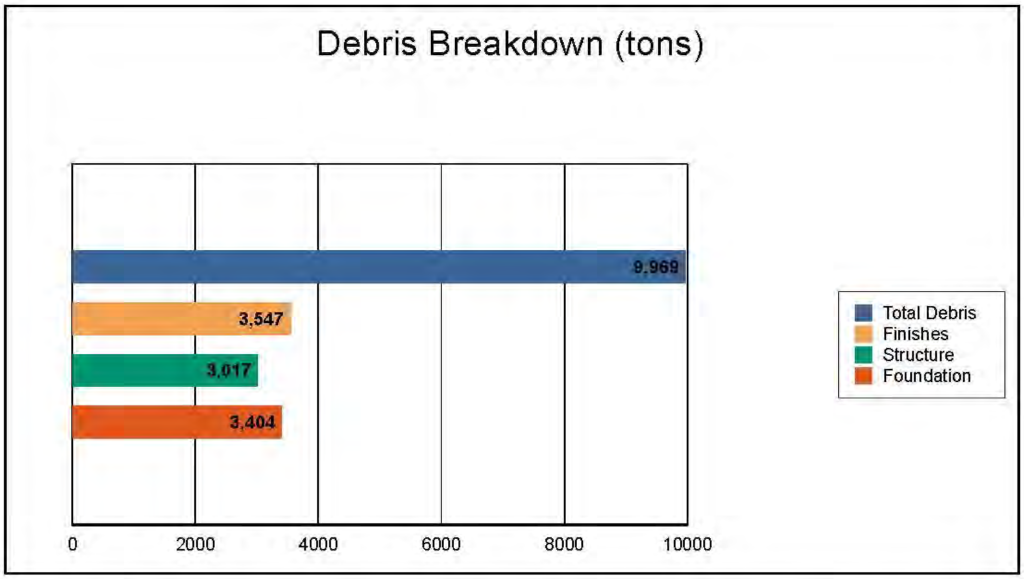
Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.



The model estimates that a total of 9,969 tons of debris will be generated. Of the total amount, Finishes comprises 36% of the total, Structure comprises 30% of the total, and Foundation comprises 34%. If the debris tonnage is converted into an estimated number of truckloads, it will require 399 truckloads (@25 tons/truck) to remove the debris generated by the flood.

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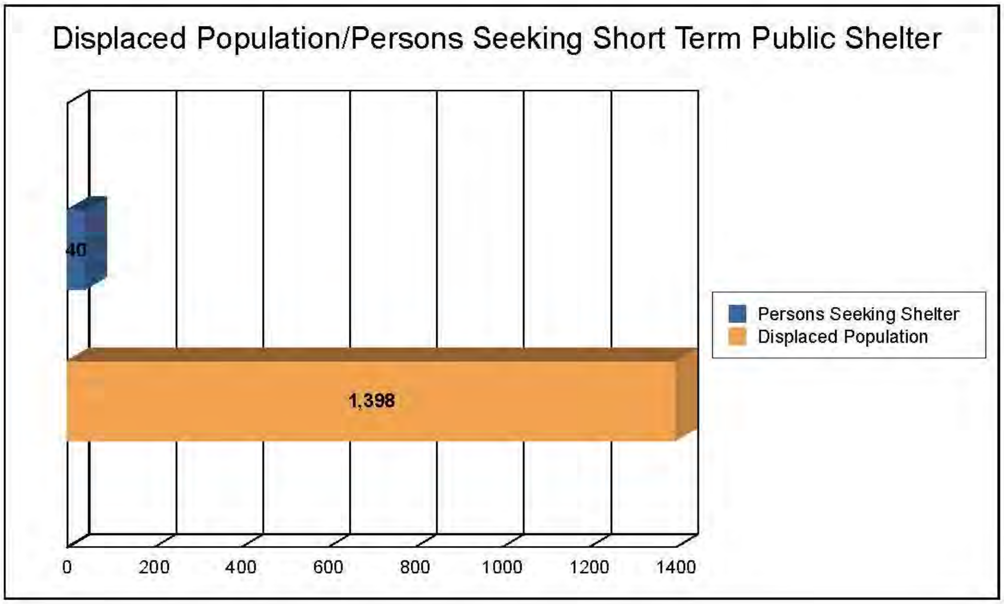
Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 466 households (or 1,398 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 40 people (out of a total population of 37,575) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 256.47 million dollars, which represents 17.52 % of the total replacement value of the scenario buildings.

Building-Related Losses

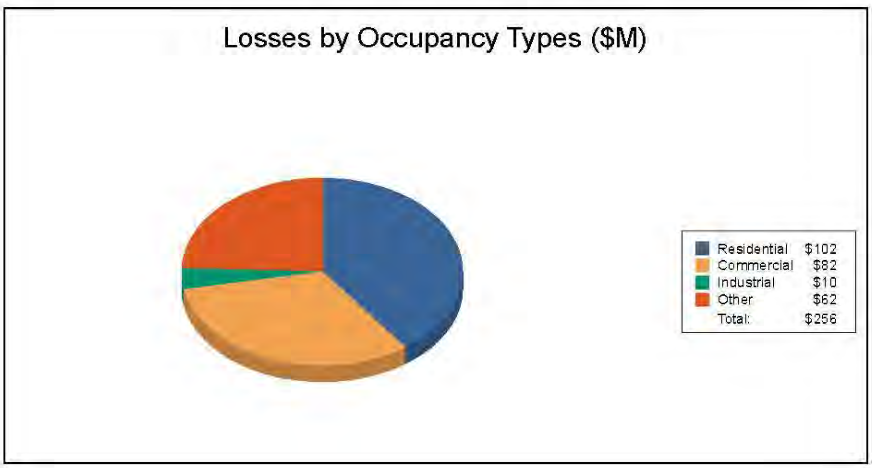
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 138.73 million dollars. 46% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 39.96% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	57.30	8.32	2.96	1.78	70.36
	Content	30.13	24.58	5.43	6.53	66.68
	Inventory	0.00	0.71	0.93	0.05	1.69
	Subtotal	**87.43**	**33.62**	**9.32**	**8.36**	**138.73**
Business Interruption						
	Income	0.18	19.00	0.12	2.61	21.91
	Relocation	10.37	5.05	0.14	1.59	17.16
	Rental Income	4.09	3.74	0.02	0.22	8.06
	Wage	0.42	20.40	0.23	49.57	70.61
	Subtotal	**15.06**	**48.20**	**0.51**	**53.98**	**117.75**
ALL	**Total**	**102.49**	**81.81**	**9.83**	**62.34**	**256.47**



Appendix A: County Listing for the Region

Virginia
- Warren

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Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Virginia				
Warren	37,575	4,029,791	776,064	4,805,855
Total	**37,575**	**4,029,791**	**776,064**	**4,805,855**
Total Study Region	**37,575**	**4,029,791**	**776,064**	**4,805,855**

City of Winchester:

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Hazus-MH: Flood Global Risk Report

Region Name: Winchester

Flood Scenario: 100

Print Date: Tuesday, February 06, 2018

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Virginia

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is approximately 9 square miles and contains 698 census blocks. The region contains over 11 thousand households and has a total population of 26,203 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 10,282 buildings in the region with a total building replacement value (excluding contents) of 3,849 million dollars. Approximately 87.41% of the buildings (and 64.48% of the building value) are associated with residential housing.

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Building Inventory

General Building Stock

Hazus estimates that there are 10,282 buildings in the region which have an aggregate total replacement value of 3,849 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,481,559	64.5%
Commercial	982,497	25.5%
Industrial	222,214	5.8%
Agricultural	9,084	0.2%
Religion	57,898	1.5%
Government	32,932	0.9%
Education	62,346	1.6%
Total	**3,848,530**	**100%**

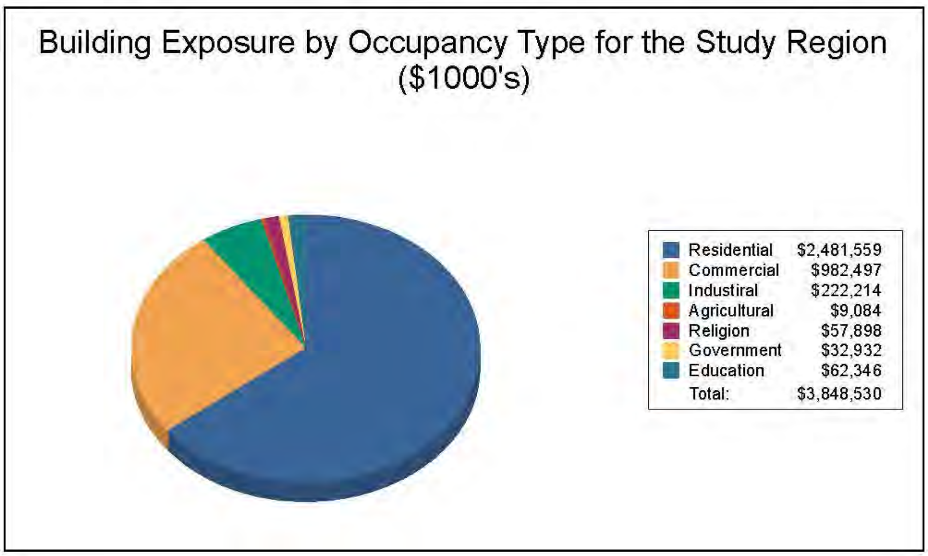

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	454,257	52.1%
Commercial	308,554	35.4%
Industrial	40,966	4.7%
Agricultural	1,264	0.1%
Religion	18,954	2.2%
Government	15,609	1.8%
Education	32,230	3.7%
Total	**871,834**	**100%**

Building Exposure by Occupancy Type for the Scenario ($1000's)

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 9 schools, 2 fire stations, 2 police stations and no emergency operation centers.

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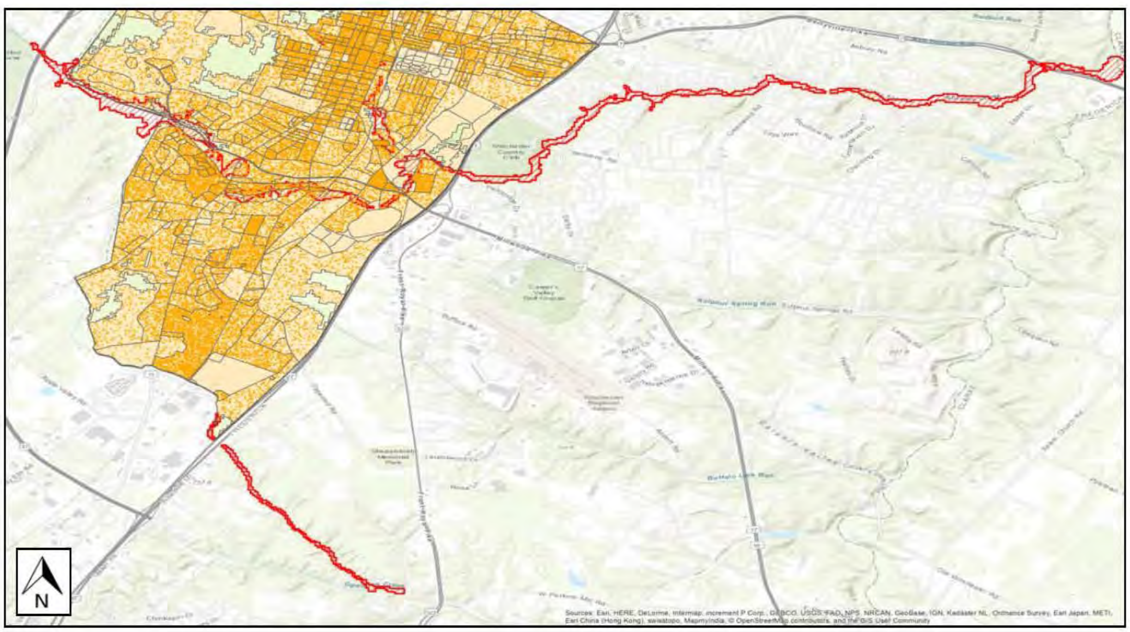
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Winchester
Scenario Name:	100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 31 buildings will be at least moderately damaged. This is over 84% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

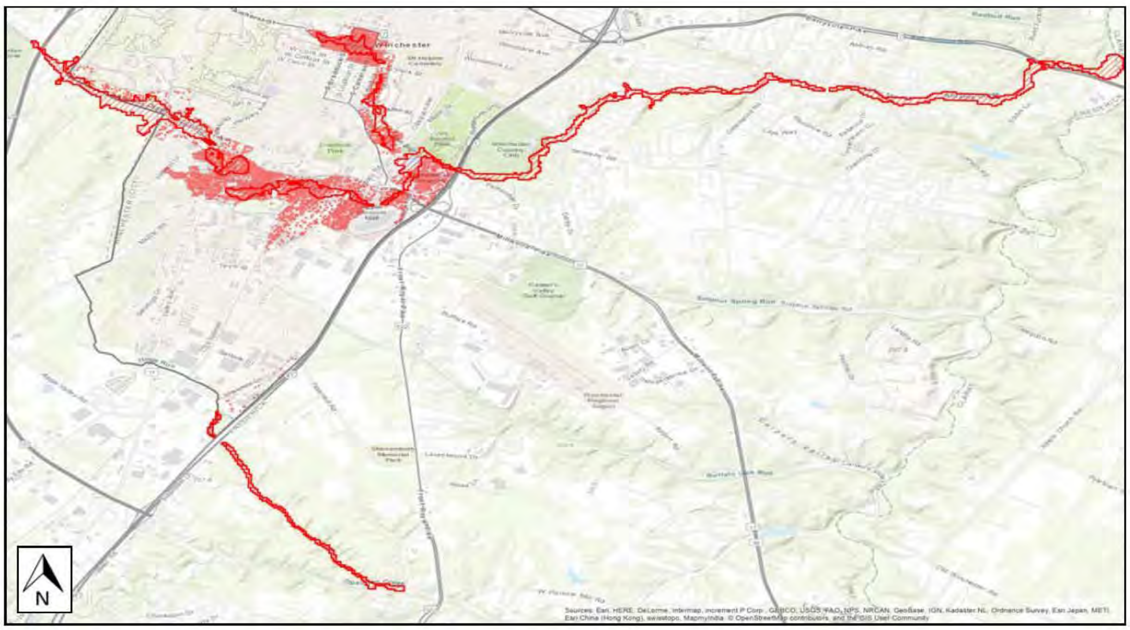


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Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	1	100	0	0	0	0	0	0	0	0	0	0
Education	1	100	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	15	33	23	50	7	15	1	2	0	0	0	0
Total	**17**		**23**		**7**		**1**		**0**		**0**	

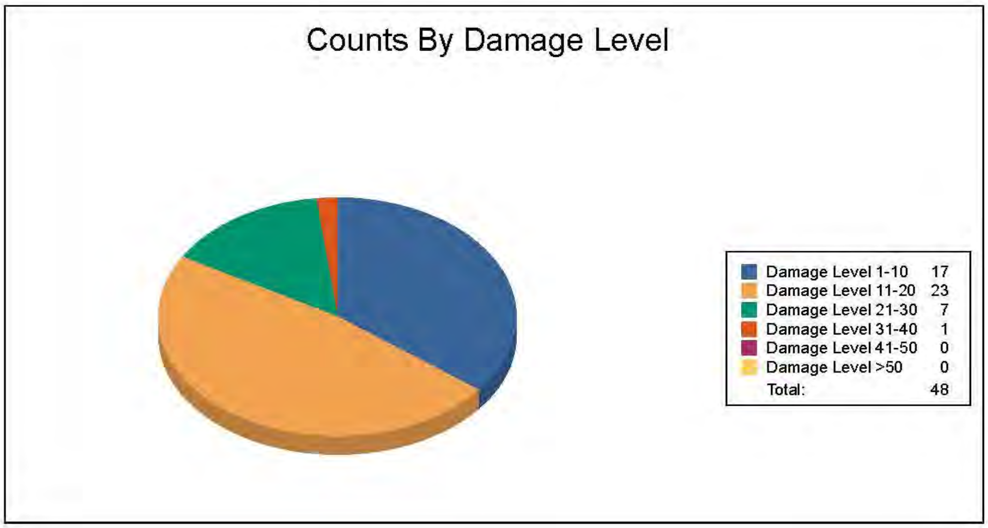


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	0	0
Masonry	4	40	5	50	1	10	0	0	0	0	0	0
Steel	1	100	0	0	0	0	0	0	0	0	0	0
Wood	13	31	21	50	7	17	1	2	0	0	0	0

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	0	0	0	0
Fire Stations	2	0	0	0
Hospitals	0	0	0	0
Police Stations	2	0	0	0
Schools	9	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

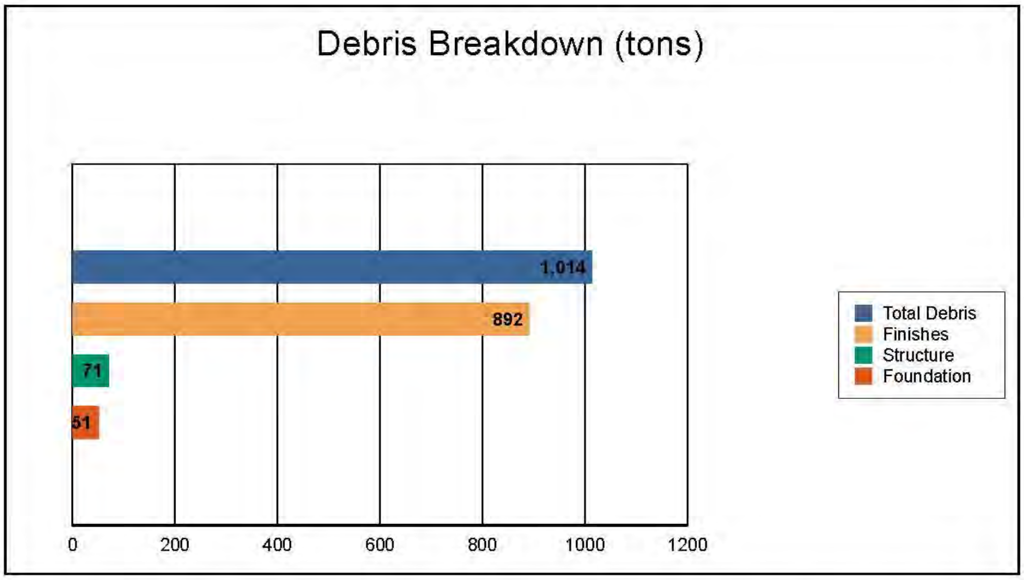
(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.



The model estimates that a total of 1,014 tons of debris will be generated. Of the total amount, Finishes comprises 88% of the total, Structure comprises 7% of the total, and Foundation comprises 5%. If the debris tonnage is converted into an estimated number of truckloads, it will require 41 truckloads (@25 tons/truck) to remove the debris generated by the flood.

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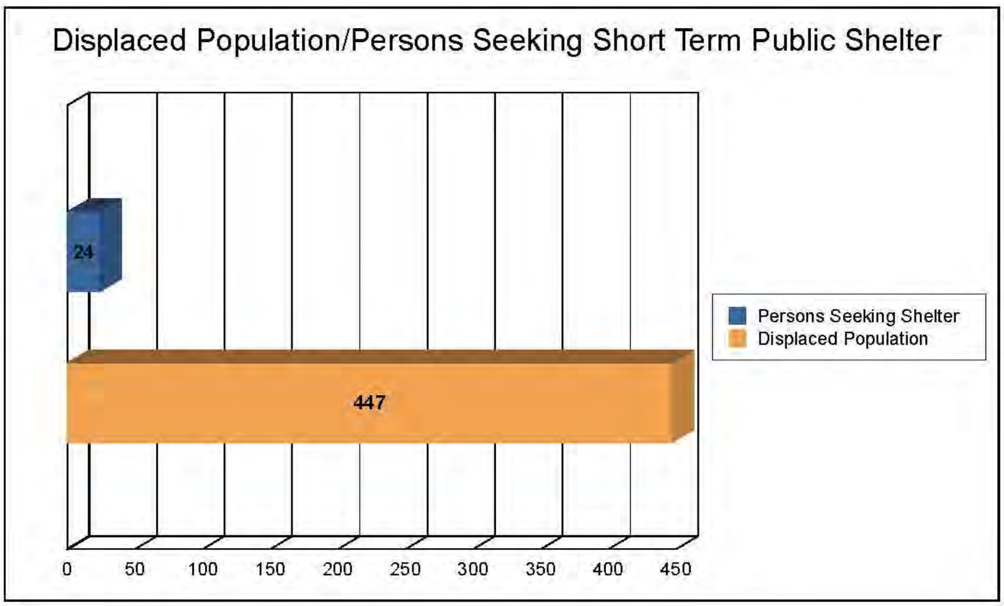
Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 149 households (or 447 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 24 people (out of a total population of 26,203) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 126.34 million dollars, which represents 14.49 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 50.76 million dollars. 60% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 14.40% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

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Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	6.75	6.34	1.73	0.78	15.60
	Content	6.44	19.54	4.02	4.13	34.12
	Inventory	0.00	0.53	0.50	0.00	1.03
	Subtotal	**13.19**	**26.42**	**6.25**	**4.91**	**50.76**
Business Interruption						
	Income	0.31	18.62	0.10	2.74	21.77
	Relocation	2.13	5.99	0.20	1.62	9.94
	Rental Income	1.82	4.34	0.03	0.27	6.46
	Wage	0.74	19.10	0.19	17.39	37.42
	Subtotal	**5.00**	**48.04**	**0.52**	**22.02**	**75.58**
ALL	**Total**	**18.19**	**74.46**	**6.76**	**26.92**	**126.34**

Losses by Occupancy Types ($M)

Appendix A: County Listing for the Region

Virginia
- Winchester

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Virginia				
Winchester	26,203	2,481,559	1,366,971	3,848,530
Total	**26,203**	**2,481,559**	**1,366,971**	**3,848,530**
Total Study Region	**26,203**	**2,481,559**	**1,366,971**	**3,848,530**

Appendix H - HAZUS-MH Regional Hurricane Global Assessment

Hazus-MH: Hurricane Global Risk Report

Region Name: NorShen

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Friday, February 09, 2018

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

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General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 6 county(ies) from the following state(s):

- Virginia

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,646.10 square miles and contains 44 census tracts. There are over 85 thousand households in the region and a total population of 222,152 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 96 thousand buildings in the region with a total building replacement value (excluding contents) of 28,662 million dollars (2014 dollars). Approximately 92% of the buildings (and 79% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 96,647 buildings in the region which have an aggregate total replacement value of 28,662 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Building Exposure by Occupancy Type

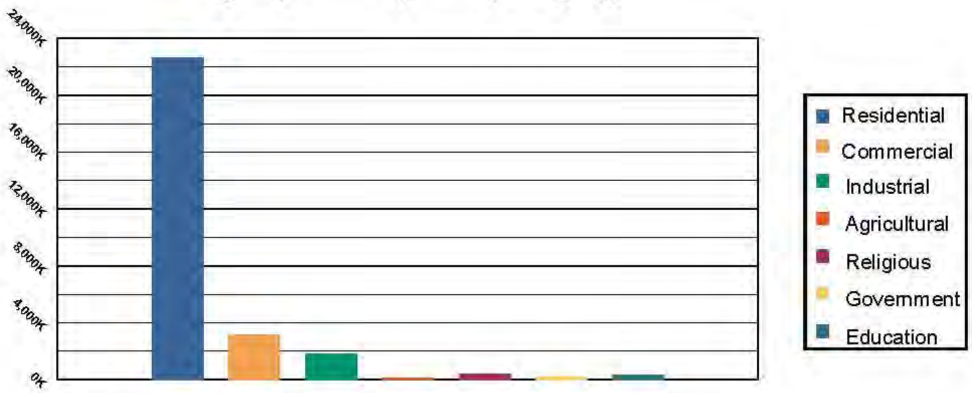

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	22,636,669	78.98 %
Commercial	3,133,440	10.93%
Industrial	1,835,615	6.40%
Agricultural	130,130	0.45%
Religious	399,583	1.39%
Government	185,439	0.65%
Education	340,778	1.19%
Total	**28,661,654**	**100.00%**

Essential Facility Inventory

For essential facilities, there are 3 hospitals in the region with a total bed capacity of 507 beds. There are 77 schools, 48 fire stations, 18 police stations and no emergency operation facilities.

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Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

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Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

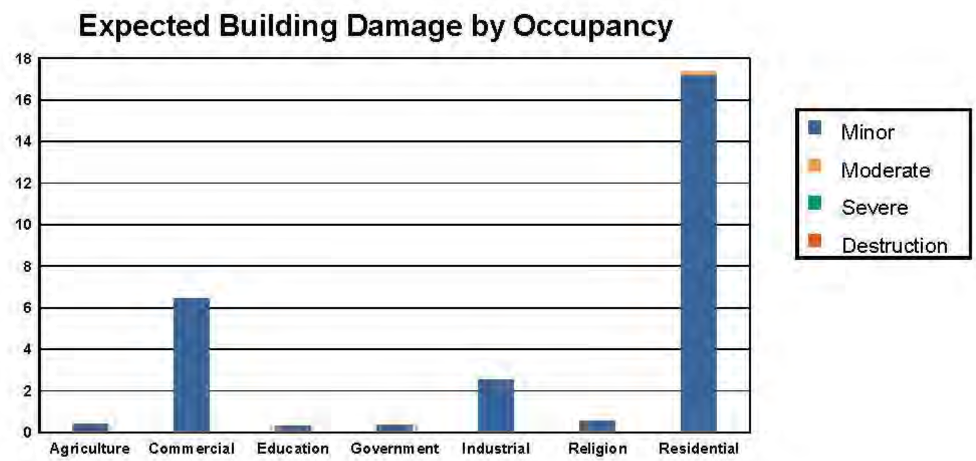

Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	487.60	99.92	0.40	0.08	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	4,649.55	99.86	6.45	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Education	195.67	99.83	0.33	0.17	0.00	0.00	0.00	0.00	0.00	0.00
Government	197.66	99.83	0.34	0.17	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	1,640.46	99.85	2.54	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Religion	590.46	99.91	0.54	0.09	0.00	0.00	0.00	0.00	0.00	0.00
Residential	88,857.64	99.98	17.23	0.02	0.12	0.00	0.00	0.00	0.00	0.00
Total	**96,619.04**		**27.84**		**0.12**		**0.00**		**0.00**	

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Essential Facility Damage

Before the hurricane, the region had 507 hospital beds available for use. On the day of the hurricane, the model estimates that 507 hospital beds (only 100.00%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

Thematic Map of Essential Facilities with greater than 50% moderate

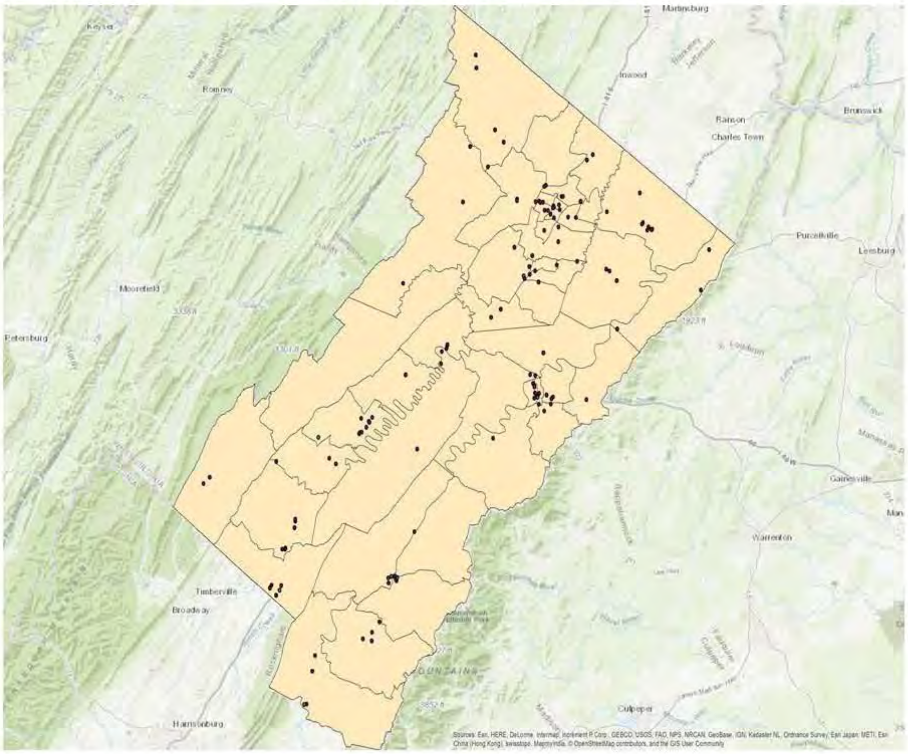
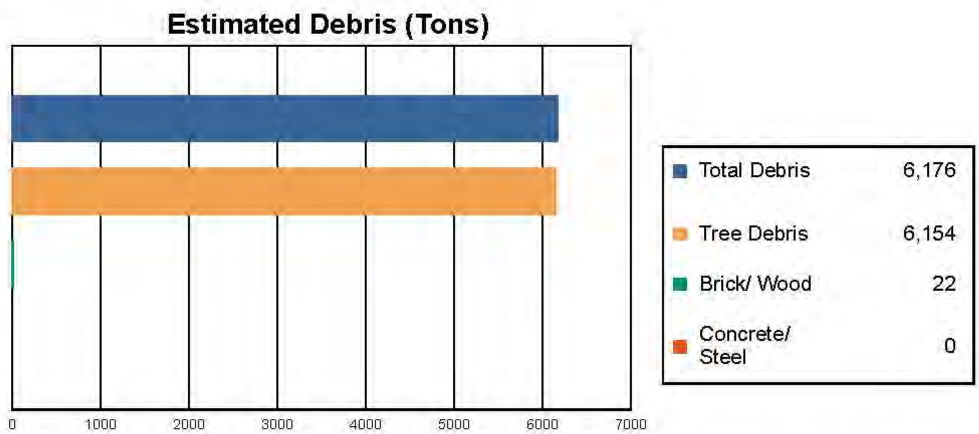


Table 4: Expected Damage to Essential Facilities

Classification	Total	# Facilities: Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	48	0	0	48
Hospitals	3	0	0	3
Police Stations	18	0	0	18
Schools	77	0	0	77

Induced Hurricane Damage

Debris Generation



Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 6,176 tons of debris will be generated. Of the total amount, 5,465 tons (88%) is Other Tree Debris. Of the remaining 711 tons, Brick/Wood comprises 3% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 1 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 689 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

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Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 222,152) will seek temporary shelter in public shelters.

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Economic Loss

The total economic loss estimated for the hurricane is 2.1 million dollars, which represents 0.01 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 2 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 99% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Total Loss by General Occupancy

Loss Type by General Occupancy

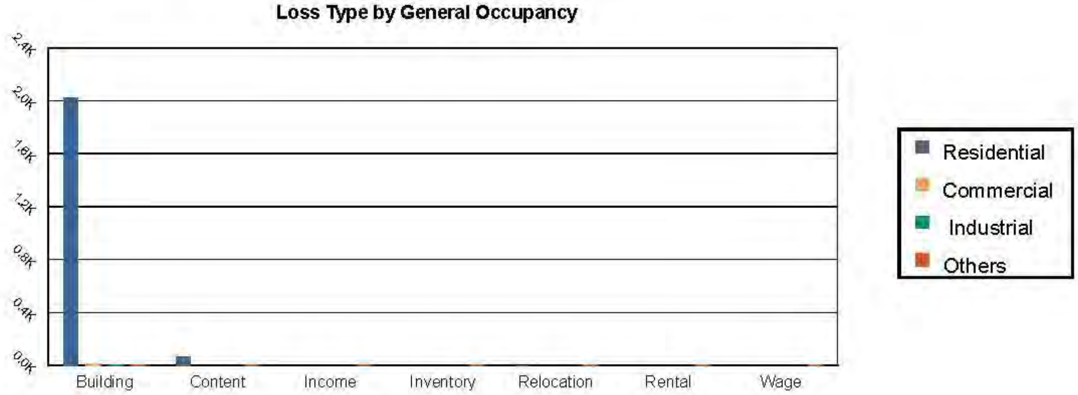

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	2,021.80	15.22	8.13	4.43	2,049.58
	Content	64.93	0.00	0.00	0.00	64.93
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**2,086.73**	**15.22**	**8.13**	**4.43**	**2,114.51**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.22	0.00	0.00	0.00	0.22
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.22**	**0.00**	**0.00**	**0.00**	**0.22**

Total

Total	2,086.95	15.22	8.13	4.43	2,114.73

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Appendix A: County Listing for the Region

Virginia
- Clarke
- Frederick
- Page
- Shenandoah
- Warren
- Winchester

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Virginia				
Clarke	14,034	1,859,838	346,774	2,206,612
Frederick	78,305	7,670,537	1,384,079	9,054,616
Page	24,042	2,075,285	457,645	2,532,930
Shenandoah	41,993	4,519,659	1,693,452	6,213,111
Warren	37,575	4,029,791	776,064	4,805,855
Winchester	26,203	2,481,559	1,366,971	3,848,530
Total	**222,152**	**22,636,669**	**6,024,985**	**28,661,654**
Study Region Total	**222,152**	**22,636,669**	**6,024,985**	**28,661,654**

Appendix I – Regional Earthquake (5mg) Global Assessment

RiskMAP
Increasing Resilience Together

Hazus-MH: Earthquake Global Risk Report

Region Name	NorShen_EQ
Earthquake Scenario:	NorshenEQ
Print Date:	February 09, 2018

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 6 county(ies) from the following state(s):

Virginia

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,645.68 square miles and contains 44 census tracts. There are over 85 thousand households in the region which has a total population of 222,152 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 96 thousand buildings in the region with a total building replacement value (excluding contents) of 28,661 (millions of dollars). Approximately 92.00 % of the buildings (and 79.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 4,168 and 2,167 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 96 thousand buildings in the region which have an aggregate total replacement value of 28,661 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 66% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 3 hospitals in the region with a total bed capacity of 507 beds. There are 77 schools, 48 fire stations, 18 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 104 hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 6,335.00 (millions of dollars). This inventory includes over 397.06 miles of highways, 438 bridges, 26,814.64 miles of pipes.

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Table 1: Transportation System Lifeline Inventory

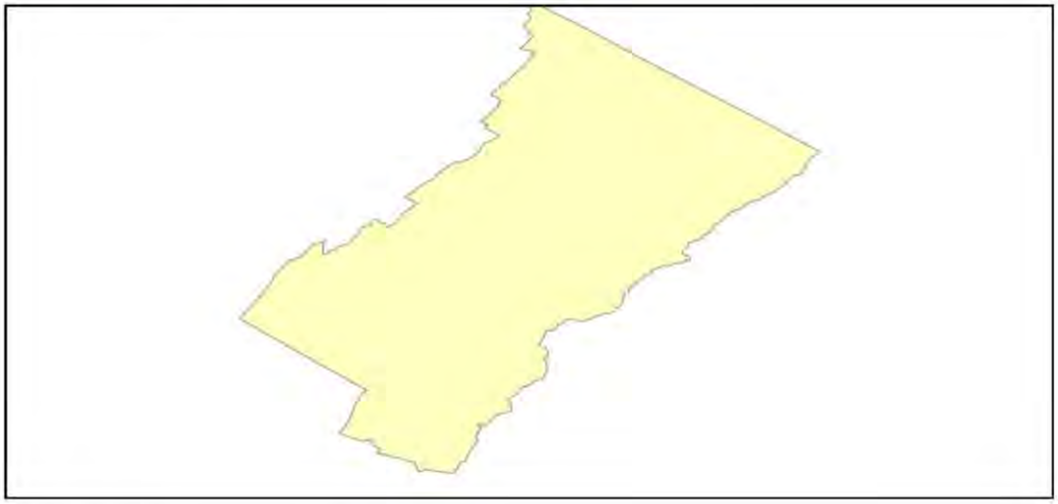
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	438	362.8290
	Segments	183	3379.7100
	Tunnels	0	0.0000
		Subtotal	**3742.6390**
Railways	Bridges	2	0.3124
	Facilities	1	2.6630
	Segments	126	276.0629
	Tunnels	0	0.0000
		Subtotal	**279.0383**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	1	1.0137
		Subtotal	**1.0137**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	3	31.9530
	Runways	3	113.8920
		Subtotal	**145.8450**
		Total	**4,168.40**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	431.5492
	Facilities	4	123.8760
	Pipelines	0	0.0000
		Subtotal	**555.4252**
Waste Water	Distribution Lines	NA	258.9295
	Facilities	19	1176.8220
	Pipelines	0	0.0000
		Subtotal	**1435.7515**
Natural Gas	Distribution Lines	NA	172.6197
	Facilities	2	2.0274
	Pipelines	0	0.0000
		Subtotal	**174.6471**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	0	0.0000
		Subtotal	**0.0000**
Communication	Facilities	23	2.1390
		Subtotal	**2.1390**
		Total	**2,168.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	NorshenEQ
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-78.36
Latitude of Epicenter	38.95
Earthquake Magnitude	5.00
Depth (km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Direct Earthquake Damage

Building Damage

Hazus estimates that about 5,627 buildings will be at least moderately damaged. This is over 6.00 % of the buildings in the region. There are an estimated 224 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

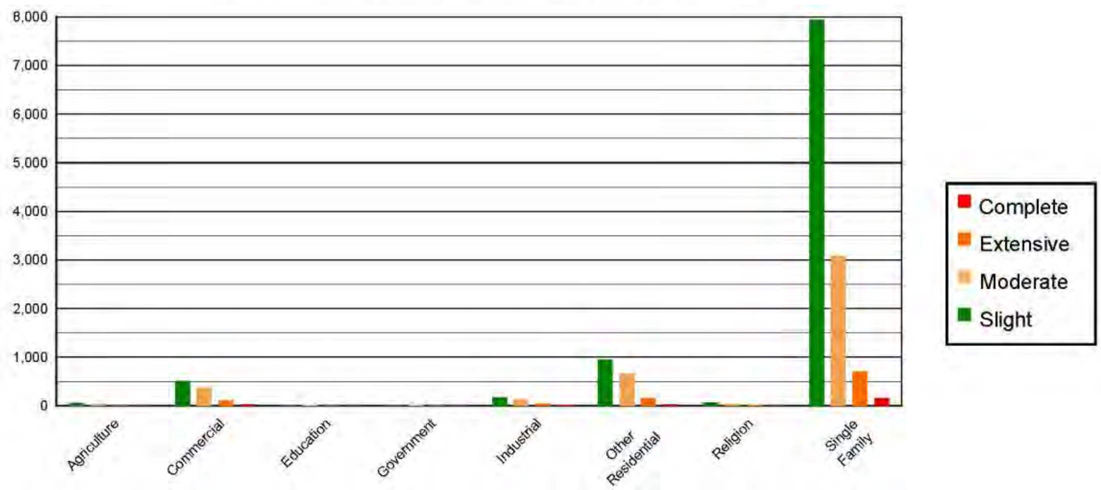


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	396.86	0.49	51.42	0.53	29.70	0.68	8.35	0.80	1.68	0.75
Commercial	3642.19	4.48	513.21	5.28	364.10	8.36	112.22	10.71	24.27	10.83
Education	159.05	0.20	19.65	0.20	13.24	0.30	3.40	0.32	0.66	0.29
Government	163.54	0.20	17.96	0.18	12.36	0.28	3.45	0.33	0.69	0.31
Industrial	1278.81	1.57	168.92	1.74	137.01	3.15	47.13	4.50	11.14	4.97
Other Residential	6194.54	7.62	952.39	9.80	668.51	15.35	160.45	15.31	28.11	12.54
Religion	472.85	0.58	63.18	0.65	39.63	0.91	12.60	1.20	2.74	1.22
Single Family	68992.65	84.86	7932.41	81.62	3090.76	70.97	700.33	66.83	154.84	69.09
Total	81,300		9,719		4,355		1,048		224	

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Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	56423.10	69.40	5528.84	56.89	1387.04	31.85	138.13	13.18	7.94	3.54
Steel	2778.80	3.42	345.31	3.55	296.79	6.81	98.08	9.36	23.29	10.39
Concrete	451.13	0.55	55.41	0.57	50.79	1.17	15.75	1.50	3.45	1.54
Precast	181.68	0.22	23.11	0.24	25.42	0.58	11.48	1.10	1.44	0.64
RM	653.53	0.80	59.57	0.61	58.57	1.34	23.06	2.20	1.74	0.78
URM	16487.15	20.28	2986.19	30.72	1986.43	45.61	633.20	60.42	164.56	73.42
MH	4325.11	5.32	720.70	7.42	550.27	12.63	128.22	12.24	21.70	9.68
Total	81,300		9,719		4,355		1,048		224	

*Note:
- RM Reinforced Masonry
- URM Unreinforced Masonry
- MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 507 hospital beds available for use. On the day of the earthquake, the model estimates that only 351 hospital beds (69.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 84.00% of the beds will be back in service. By 30 days, 96.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	3	0	0	2
Schools	77	3	0	66
EOCs	0	0	0	0
PoliceStations	18	1	0	14
FireStations	48	2	0	40

Transportation Lifeline Damage

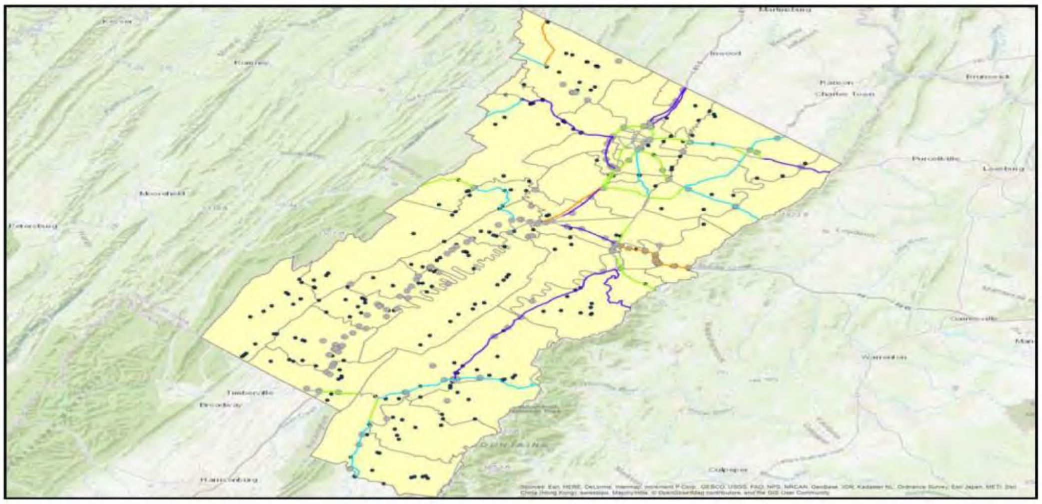

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	183	0	0	183	183
	Bridges	438	7	0	434	438
	Tunnels	0	0	0	0	0
Railways	Segments	126	0	0	126	126
	Bridges	2	0	0	2	2
	Tunnels	0	0	0	0	0
	Facilities	1	0	0	1	1
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	1	0	3	3
	Runways	3	0	0	3	3

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	4	1	0	3	4
Waste Water	19	4	0	13	19
Natural Gas	2	1	0	1	2
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	23	4	0	21	23

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	13,408	570	143
Waste Water	8,045	286	72
Natural Gas	5,363	98	25
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	85,887	11	0	0	0	0
Electric Power		6,902	4,257	1,595	258	8

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Induced Earthquake Damage

Fire Following Earthquake

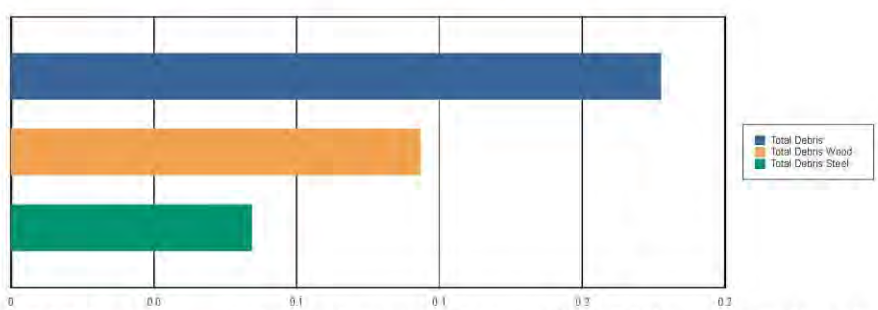
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 182,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 63.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 7,280 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
0.11	0.07	0.18	7,280 (@25 tons/truck)

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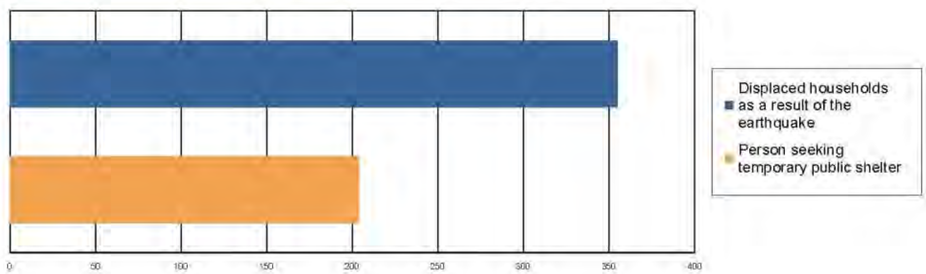
Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 355 households to be displaced due to the earthquake. Of these, 204 people (out of a total population of 222,152) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter



Displaced households as a result of the earthquake	Persons seeking temporary public shelter
355	204

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1:Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2:Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3:Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4:Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	1.37	0.29	0.04	0.07
	Commuting	0.02	0.02	0.04	0.01
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	3.23	0.69	0.09	0.17
	Other-Residential	20.00	3.69	0.39	0.74
	Single Family	106.98	21.10	2.63	5.13
	Total	132	26	3	6
2 PM	Commercial	81.22	16.94	2.11	4.08
	Commuting	0.15	0.18	0.33	0.06
	Educational	31.11	6.68	0.89	1.72
	Hotels	0.00	0.00	0.00	0.00
	Industrial	23.82	5.12	0.64	1.24
	Other-Residential	4.37	0.83	0.09	0.17
	Single Family	23.88	4.90	0.64	1.20
	Total	165	35	5	8
5 PM	Commercial	58.50	12.28	1.55	2.95
	Commuting	3.05	3.62	6.65	1.26
	Educational	2.03	0.44	0.06	0.11
	Hotels	0.00	0.00	0.00	0.00
	Industrial	14.89	3.20	0.40	0.78
	Other-Residential	7.63	1.44	0.16	0.29
	Single Family	42.81	8.72	1.14	2.12
	Total	129	30	10	8

Economic Loss

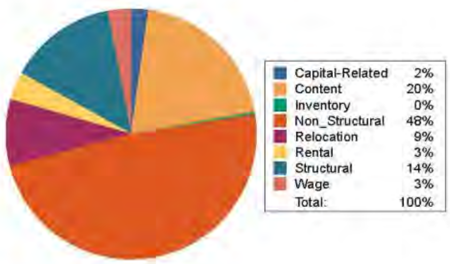
The total economic loss estimated for the earthquake is 747.46 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 625.31 (millions of dollars); 17 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 70 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

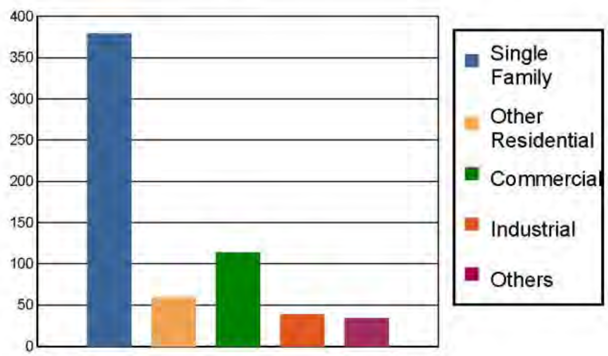


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	2.1241	13.4601	0.7281	2.0070	18.3193
	Capital-Related	0.0000	0.9058	11.8506	0.4329	0.2863	13.4756
	Rental	10.0136	4.0741	6.3591	0.3385	0.4716	21.2569
	Relocation	34.8975	3.2912	9.8428	2.0257	4.6719	54.7291
	Subtotal	**44.9111**	**10.3952**	**41.5126**	**3.5252**	**7.4368**	**107.7809**
Capital Stock Losses							
	Structural	56.9436	7.2051	13.8968	5.1155	4.9472	88.1082
	Non_Structural	201.1077	32.8258	37.1707	16.7399	13.7513	301.5954
	Content	75.9653	9.2286	20.4252	11.4031	8.2561	125.2783
	Inventory	0.0000	0.0000	0.5794	1.8643	0.1057	2.5494
	Subtotal	**334.0166**	**49.2595**	**72.0721**	**35.1228**	**27.0603**	**517.5313**
	Total	**378.93**	**59.65**	**113.58**	**38.65**	**34.50**	**625.31**

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Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3379.7100	0.0000	0.00
	Bridges	362.8290	7.1268	1.96
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**3742.5390**	**7.1268**	
Railways	Segments	276.0629	0.0000	0.00
	Bridges	0.3124	0.0015	0.48
	Tunnels	0.0000	0.0000	0.00
	Facilities	2.6630	0.5794	21.76
	Subtotal	**279.0383**	**0.5809**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	1.0137	0.0394	3.89
	Subtotal	**1.0137**	**0.0394**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	31.9530	4.7800	14.96
	Runways	113.8920	0.0000	0.00
	Subtotal	**145.8450**	**4.7800**	
	Total	**4,168.44**	**12.53**	

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Table 13: Utility System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	123.8760	8.7418	7.06
	Distribution Line	431.5492	2.5660	0.59
	Subtotal	**555.4252**	**11.3078**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	1176.8220	96.0816	8.16
	Distribution Line	258.9295	1.2889	0.50
	Subtotal	**1435.7515**	**97.3705**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	2.0274	0.3391	16.73
	Distribution Line	172.6197	0.4416	0.26
	Subtotal	**174.6471**	**0.7807**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Communication	Facilities	2.1390	0.1571	7.34
	Subtotal	**2.1390**	**0.1571**	
	Total	**2,167.96**	**109.62**	

Appendix A: County Listing for the Region

Clarke,VA

Frederick,VA

Page,VA

Shenandoah,VA

Warren,VA

Winchester,VA

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Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Virginia					
	Clarke	14,034	1,859	346	2,206
	Frederick	78,305	7,670	1,384	9,054
	Page	24,042	2,075	457	2,532
	Shenandoah	41,993	4,519	1,693	6,213
	Warren	37,575	4,029	776	4,805
	Winchester	26,203	2,481	1,366	3,848
Total Region		222,152	22,633	6,022	28,658

Appendix J - Guide to Mitigation Strategies

Appendix G. Guide to Mitigation Strategies[1]

Mitigation strategies or activities fall into six general categories. These categories are explained in the next section. The second and third sections provide more detail on common mitigation activities.

I. General Categories

Prevention

Preventative activities are intended to keep hazard problems from getting worse. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or where capital improvements have not been substantial. Examples of preventative activities include:

- Open space preservation
- Storm water management
- Drainage system maintenance
- Shoreline/riverine setbacks
- Capital Improvement Plans/critical facility placement
- Special assessment districts

Local land use plans and ordinances can be used to limit development in hazard-prone areas or to prevent areas from becoming worse. Examples of local enforcement tools that can be used include:

- Planning and zoning
- Floodplain regulations

Property Protection

Property protection measures protect new or existing structures by modifying buildings to withstand hazardous events, or removing structures from hazardous locations. Examples include:

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[1] This document is based, in part, on the City of Chesapeake (VA) Hazard Mitigation Plan. Portions of this document also were drawn from the *Tools and Techniques: An Encyclopedia of Strategies to Mitigate the Impact of Natural Hazards* developed by the State of North Carolina in 2002, and the *Planning for Natural Hazards: Oregon Technical Resource Guide* developed by the Oregon Natural Hazards Workgroup, Community Service Center at the University of Oregon.

- Acquisition
- Relocation
- Building elevation
- Critical facilities protection
- Building codes (enforcement)
- Safe rooms
- Basement backflow prevention
- Retrofitting (i.e., windproofing, floodproofing, seismic design standards, etc.)
- Wind shutters

Natural Resource Protection

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

- Floodplain protection
- Riparian buffers
- Vegetative planting and treatment / slope stabilization / fire-resistant landscaping
- Fuel breaks
- Wetland preservation and restoration

Structural Projects

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

- Channel modification
- Levees / dikes / floodwalls
- Diversions / detention / retention
- Reservoirs
- Utility protection / upgrades
- Wind retrofitting / windproofing

Emergency Services

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

- Warning systems

- Evacuation planning and management
- Sandbagging for flood protection

Public Information and Awareness

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

- Speaker series/demonstration events
- Hazard map information
- Real estate disclosure
- Library materials
- School children education
- Hazard expositions
- Websites

II. General Multi-Hazard Mitigation Activities

The following potential mitigation activities can be used to address one or more hazards. These activities also can benefit a community's overall hazard reduction efforts. Activities that are specific to a particular hazard are explained in the third section.

The mitigation activities selected should be linked to the Planning District's goals and objectives, and must address each jurisdiction's hazard risks and vulnerability outlined in the plan's Hazard Identification and Risk Assessment.

Building Codes

Building codes regulate the design, construction, and maintenance of construction within most communities. These regulations prescribe standards and requirements for occupancy, maintenance, operation, construction, use, and appearance of buildings. Building codes are an effective way to ensure than new and extensive re-development projects are built to resist natural hazards. In Virginia, communities are required by law to adopt and enforce the Uniform Statewide Building Code, which has provisions for wind, water, and seismicity. Changes to the code are made by petitioning the International Code Council.

The USBC provides optional enforcement regulations to protect occupants of existing buildings and structures from health and safety hazards arising from the improper maintenance and use of those buildings and structures. Enforcement of the building code for new and existing structures is key to realizing the full health and safety benefits of the code.

Capital Improvement Plans/Critical Facility Placement

Capital improvement plans typically provide for the future and ongoing provision of public facilities and infrastructure. These plans can be vital tools in keeping new development out of high-hazard areas by limiting the availability of public infrastructure. Public facilities can often be relocated to less hazardous areas in the aftermath of a disaster. Public utilities also can be relocated, or they can be upgraded or floodproofed. Power and telephone lines can be buried underground.

In order to maximize the gravity flow area of wastewater treatment plants, the facilities are often located at the lowest elevation in the community. If this point lies within a floodplain for example, consideration may be given to relocating or floodproofing such facilities. New locations for critical facilities should not be in hazard-prone areas, or in areas where their function may be impaired by a given hazard event (i.e., where water can flood the access roads). Critical facilities should be designed and/or retrofitted in order to remain functional and safe before, during, and after a hazard event.

Comprehensive Plans

Comprehensive plans address how and where a community should grow by guiding the rate, intensity, form, and quality of physical development. These plans address land use, economic development, transportation, recreation, environmental protection, the provision of infrastructure, and other municipal functions. Comprehensive plans help to guide other local measures such as capital improvement programs, zoning ordinances, subdivision ordinances and other community policies and programs. By including natural hazard considerations into the plan, mitigation becomes integrated with community functions and could therefore be an institutionalized part of a jurisdiction's planning efforts.

Density and development patterns should reflect the Planning District communities' ability to protect their jurisdictions, the environment, and the ability to evacuate the area. Development management tools should be incorporated into the local policies that address the location, density, and use of land, with a particular emphasis on development within high-risk areas. Efforts should be made to keep people and property out of high-hazard areas whenever possible. Particularly hazardous areas could be used for recreational uses, open space, or wildlife refuges.

Critical Facilities Protection

Critical facilities, such as hospitals, fire and police stations, and sewage treatment plants are crucial for day-to-day survival of a community. Ensuring that these facilities have been built to withstand the impacts of natural disasters is crucial. This includes placement of the buildings in areas that are not hazard-prone and incorporating mitigation measures such as floodproofing, wind shutters, and hurricane straps into the construction of the building.

Evacuation Planning and Management

An orderly and safe evacuation requires planning and a pre-determined management strategy. This includes pre-identifying emergency evacuation routes and communicating that information to the public. In addition, people needing assistance, such as the elderly or those with special needs, should be identified and plans made to assist them if an evacuation were to occur.

Another component of evacuation planning is ensuring that shelter facilities will be available. Potential shelter locations must be identified and publicized and efforts must be made to ensure that the proper supplies and staff are available if the shelter is activated.

Neighborhood Access

Provide additional means of access into single-entry neighborhoods, in order to prevent residents from becoming trapped in a hazardous area during a wildfire or flood.

Public Outreach and Education Programs

Educating the public about what actions they can take to protect themselves and their property from the effects of natural hazards can be an effective means for reducing losses. These types of programs could target public officials, citizens, businesses, or the local construction trade. The program could cover preparedness, recovery, mitigation, and general hazard awareness information. Potential outreach and education topics include:

- Flood insurance
- Hazard mitigation for homeowners (including manufactured homes and trailers), renters, and businesses
- Emergency preparedness for families, businesses, and special needs populations
- Driver safety in disasters
- Sheltering and evacuation

Ways of delivering this information include:

- Speaker series / demonstration events
- Hazard expositions
- Hazard curriculums for schools
- Hazard map dissemination
- Real estate disclosure
- Library materials
- Websites

Special Assessment Districts

Special assessment districts apply to property owners who directly benefit from a specific public improvement. These owners of both new and existing development in the district are charged a fee that is proportional to the benefits received from the improvement. There are a number of ways to apply this technique, from temporary assessments that raise revenue for a specific improvement to indefinite assessments that fund independent, special purpose governmental entities. The former could be used to fund structural projects, such as a floodwall, while the latter could be used to establish a regional floodplain management organization.

Another example might be the creation of a "special storm services" district, where funds would go toward mitigation, recovery and response activities. In other cases, the fee could be used to pay for the upkeep of stormwater management system or as a way of providing for the future replacement of roads and utilities at the public expense. These charges may or may not have the effect of discouraging development in the assessment district. However, they do transfer some of the cost of living or doing business in a hazard-prone area to those who choose to do so.

Utility Protection/Upgrading

Buried power lines can offer uninterrupted power during and after severe storms (both wind and winter storms). Burying power lines can significantly enhance a community's ability to recover in the aftermath of a disaster. Buried power lines are typically more expensive to maintain and are more vulnerable to flooding. Encouraging back-up power resources in areas where burial is not feasible will enable the continuity of basic operations (e.g., security, refrigeration, and heat) for businesses and facilities when there is a loss of power.

Vegetative Maintenance

Vegetative maintenance is the pruning and maintenance of trees, bushes, and other vegetation that could increases threats to power lines during storms, or could act as fuels during wildfires. This could be applied in limited areas that have a significant vulnerability to these hazards, such as within utility easements or along the urban-wildland interface.

Vegetative Planting and Treatment/ Fire-resistant landscaping

Vegetative planting and treatments can help to capture and filter runoff or reduce wildfire risk depending on the types of plants used. Perennial vegetation includes grass, trees, and shrubs that cover the soil, reduce water pollution, slow the rate of runoff, increase filtration, and prevent erosion. This type of land treatment includes maintaining trees, shrubberies, and the vegetative cover; terracing (i.e., a raised bank of earth with vertical sloping sides and a flat top to reduce surface runoff); stabilizing slopes; grass filter strips; contour plowing; and strip farming (i.e., the growing of crops in rows along a contour). Other potential options include vegetated swales, infiltration ditches, and permeable paving blocks.

Landscaping also makes a difference in the vulnerability of a property to wildfire.

Warning Systems

Warning systems are comprised of two components: monitoring of local conditions and the broadcasting of alerts. An example of monitoring is a system of stream gauges that provide real-time data.

The National Weather Service uses broadcasts via NOAA Weather Radio to alert communities of meteorological events such as floods and tornadoes. Reverse 911 systems and the media (e.g., television, radio) also can be used to alert residents to hazardous situations.

Zoning

Zoning is by far the most common land use control technique used by local governments. While a useful tool for regulating and restricting undesirable land uses, zoning has a somewhat more limited benefit when it comes to mitigation. Zoning is most effective on new development rather than existing development, which does little to address the pre-existing development in hazardous areas. Communities with a large amount of undeveloped land will benefit much more than older, more established communities.

A community might create an overlay zone for high-hazard districts that establishes mitigation requirements for development in those districts. Overlays are also useful for periods of reconstruction. A recovery overlay zone would include temporary planning regulations that might strictly limit reconstruction in the hazard area or could require any new development to include hazard mitigation techniques. The overlay zone would remain transparent until it was triggered by a disaster event.

Even for new development, the issuance of variances, special use permits, rezoning, and the failure to enforce existing codes, however, will weaken zoning's ability to prevent certain types of building practices.

III. Hazard-Specific Activities

The following is a list of potential mitigation activities that are hazard-specific.

Flood

Flood mitigation measures can be classified as structural or non-structural. In simple terms, structural mitigation attempts to eliminate the possibility of flooding at a particular location. Non-structural mitigation removes the potentially affected people or property from the potentially flooded area. The following is a description of potential flood mitigation measures.

Floodplain Management Ordinances

Floodplain management addresses the hazard risk of communities partially or entirely located in a floodplain. Floodplain management ordinances should restrict development that would increase flood heights and ensure that construction materials and methods used will minimize future flood damage.

Floodplain management ordinances are weakened by development pressures, a lack of suitable sites outside of the floodplain, community desires to be near the water, inability to effectively monitor floodplain management activities, or by land use planning policies that are encouraging development into floodplain areas.

Acquisition

Acquisition involves the purchasing of property in a hazardous area, which is subsequently cleared and permanently held as open space. Acquisition permanently moves people and property out of harm's way, increases floodplain capacities, recreation areas and open space, and can help to preserve wetlands, forests, estuaries and other natural habitats. Participation in federally-funded grant programs requires voluntary participation by the owner.

Acquisition programs can be expensive to undertake, and the property will no longer accrue taxes for the community and must be maintained, but it is by far the most effective and permanent mitigation technique. Acquisition is most effective when targeting repetitive loss structures, extremely vulnerable structures, or other high-hazard areas.

Basement Backflow Prevention

Check valves, sump pumps, and backflow prevention devices in homes and buildings can be used to prevent flooding in basements from sewer backflows. This option can be done only if the infrastructure allows it.

Channel Modification

Changes to the stream bed, such as dredging or lining the channel, can improve the flow and capacity of the stream. By improving the ability of the stream to move surplus water, the flood risk can be reduced. Channelization projects are designed to move water quickly away from developed areas.

Dry Floodproofing

Dry floodproofing involves making all areas below the flood protection level watertight by strengthening walls, sealing openings, using waterproof compounds, or applying plastic sheeting on the walls. This method is not recommended for residential structures, but may work well for new construction, retrofitting, or repairing a non-residential structure. Due to pressure exerted on walls and floors by floodwater, dry floodproofing is effective on depths less than 2 to 3 feet. Floodproofing of basements is not recommended.

Elevation

Elevation is the raising of a structure above the Base Flood Elevation. Elevation is often the best alternative for structures that must be built or remain in flood-prone areas, and is less costly than acquisition or relocation. However, elevating a structure can increase its vulnerability to high winds and earthquakes. Some building types are either unsuitable or cost-prohibitive to elevate.

Open Space Preservation

Local government can purchase land to prevent development from occurring in hazard-prone areas. Land can be bought through fee simple purchase or conservation easements could be sought. The land can be used as community open space or for recreational purposes, potentially meeting other community goals.

Relocation

Relocation involves the moving of a building or facility to a less hazardous area, on either the same parcel or another parcel. This measure also moves people and property out of harm's way, and is a very effective measure overall. Some building types are either unsuitable or cost-prohibitive to relocate.

Reservoirs

Reservoirs can be used to store water for various purposes including municipal water sources, recreational uses, and flood control. Water can be stored and released at a controlled rate so as not to overwhelm the downstream channel.

Riparian Buffers

Riparian buffers prevent development within a certain distance from a stream or river. The buffer typically retains its natural vegetation that often can retain greater amounts of water than bare soil and thus help to mitigate flood level. The plant roots hold soil in place and slow movement of floodwaters, lessening erosion and sedimentation, while increasing groundwater infiltration. This increased groundwater infiltration may also improve water quality by reducing the amount of sediment and pollutants flowing into the stream.

Sandbagging

"Sandbags can be used to fill gaps in a permanent protection system, to raise an existing levee or to build a complete emergency levee. Sandbags alone, when filled and stacked properly, can hold back flood water, but they are most effective when used with polyethylene (plastic) sheeting."[2]

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[2] *Using Sandbags for Flood Protection.* Retrieved from http://www.louisianafloods.org/Mitigation/sandbagsmain3.html on December 20, 2004.

Shoreline / Riverine Setbacks

Setbacks establish a minimum distance between an existing shoreline or stream/river and the buildable portion of a lot. By moving the building away from a potential hazard, the risk to the building is reduced. Setbacks also may be used to move development away from steep slopes that are at risk for failure (e.g., landslide).

Stormwater Management / Storm Drainage Systems / Retention and Detention Facilities

New development that increases the amount of impervious surfaces affects the land's ability to absorb the water and can intensify the volume of peak flow runoff. Without efficient stormwater management, runoff could cause flooding, erosion, and water quality problems. Stormwater management plans should incorporate both structural and nonstructural measures in order to be most effective.

Mitigation efforts include the installation, re-routing, or increasing the capacity of storm drainage systems. Examples include the separation of storm and sanitary sewers or drainage easements. Other structural measures include retention and detention facilities that minimize the increase of runoff due to impervious surfaces and new development. Retention facilities allow stormwater to seep into the groundwater. Detention systems accumulate water during peak runoff periods that will be released at off-peak times. Nonstructural measures include establishing impervious surface limit policies and maintenance programs for existing drainage systems.

Stream/Channel Maintenance

Waterways should be cleared of debris to allow for the free flow of water during a flood event. If streams or rivers are clogged with debris, damming could occur As a result, areas upstream and adjacent to the unintended dam can receive unanticipated higher flood levels. In addition, downstream areas may be vulnerable to higher flooding if and when the dam breaks.

Structural Flood Control Measures

Water can be channeled away from people and property with structural control measures such as levees, dams, or floodwalls. These measures also may increase drainage and absorption capacities. These structural control measures also may increase Base Flood Elevations and therefore could create a false sense of security.

Wet Floodproofing

The opposite of dry floodproofing, wet floodproofing lets the floodwater actually enter a structure. This technique is effective on deeper flood depths, as it does not have the same potential to build up exterior pressure. Again, this method is not recommended for residential structures and may not be used for basements under new construction, substantial improvements, or substantially damaged structures.

Wetland Preservation and Restoration

Wetlands can store floodwaters and decrease overall flow downstream, thereby reducing the flood risk. Wetlands also act as filters for pollutants, therefore, increasing water quality. Its usefulness as a mitigation technique may decrease with the size of the flood.

Wind

Proper engineering and design of a structure can increase a structure's ability to withstand the lateral and uplift forces of wind. Building techniques that provide a continuous load path from the roof of the structure to the foundation are generally recommended.

Community Shelters/Safe Rooms

Community shelters and concrete safe rooms can offer protection and reduce the risk to life. Locations for these shelters or safe rooms are usually in concrete buildings such as shopping malls or schools. Communities lacking basements and other protection nearby should consider developing tornado shelters.

Windproofing

Windproofing is the modification of the design and construction of a building to resist damages from wind events, and can help to protect the building's occupants from broken glass and debris. Windproofing involves the consideration of aerodynamics, materials, and the use of external features such as storm shutters. These modifications could be integrated into the design and construction of a new structure or applied to reinforce an existing structure.

Manufactured homes, which tend to be vulnerable to the effects of extreme wind events, can be protected by anchoring the structures to their foundations. Mobile homes could be tied down to their pads in order to prevent them from being destroyed. Public facilities, critical infrastructure, and public infrastructure (such as signage and traffic signals) should all be windproofed in vulnerable areas. However, windproofing is not a viable mitigation technique to protect against tornadoes.

Wind Shutters

Wind or hurricane shutters can reduce the damages from high winds by preventing windows from breaking allowing wind and rain to enter a structure. Shutters come in various materials and can be purchased or built from scratch.

Wildfire

Fuel Breaks

Fuel breaks are used to prevent the spread of a wildfire. Fuel breaks are areas where vegetation and other fuels have been cleared. Roads and driveways can act as fuel breaks.

Appendix K – 2012 Mitigation Strategies

The above regional m1t1gation strategies are applicable to each of the participating twenty localities. In addition, the Counties and Towns and the City of Winchester have specific strategies which are presented below.

Clarke County, Towns of Berryville and Boyce:

Action Plan to implement Strategies						
Clarke County, Town of Berryville, Town of Boyce						
Mitigation Action	Priority	Hazard(s)	Goals (1-6) / Actions(A-D)	Responsible Dept / Status	Funding Source	Target Completion Date
Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day).	H	All	2 / 0.1, 0.0.2, 0.3, D.4	Communications, Emergency ManagemenV In progress	VDEM	2 years from Plan Adoption
Conduct public education on the principles of "sheltering inplace."	M	All	6 / A.1-A.6	Planning / In progress	VDEM	1 Year after adoption of Plan
Educate residents and business owners about reducing possible wind-borne debris (e.g., anchoring storage sheds, moving outdoor furniture indoors, trimmina trees).	M	hurricane, Tornado, Severe Stonn	5, 6 / A.1-A.6, D.1-0.3	Planning/ In progress	VDEM	2 years after Plan Adoption
Encourage public and private water conservation plans, including consideration of rainwater catchment system.	M	Drought	5, 6 / A.1-A.6, D.1-D.3	Planning/ In progress	VDEM	1 Year after adoption of Plan
Work with the Virginia Department of Forestry to implement the FIREWISE program in Clarke County and localities.	M	Wildfires	5, 6 / A.1-A.6, D.1-D.3	Planning/ In progress	VDEM	2 years after Plan Adoption
Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury and or oroaertv damaae.	H	All	2 / 8.1-8.5, D.4	GIS, Planning/ In progress	Locality, VDEM	1 Year after adoption of Plan

Consider providing necessary electrical hook-up, wiring, and switches to allow readily accessible connections to emergency generators at key critical public facilities.	M	All	4 / C.1-C4, D.1-D.4	Emergency ManagemenV In progress	VDEM	2 years after Plan adoption
Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FIRMs).	M	Flood	1,2 / C.1-C.4, D.1-D4	GIS, Planning/ In progress	VDEM	2 years after Plan adoption
Link structure value data with tax parcel GIS database to increase accuracy of loss estimates	M	All	1,2 / C.1-C.4, D.1-D4	GIS, Planning/ In progress	VDEM	2 years after Plan adoption
Encourage purchase of NOAA radios. Provide NOAA weather radios to public facilities.	H	All	2 / D.1, D.D2, D.3, D.4	Communications, Emergency ManagemenV In progress	VDEM	2 years after Plan adoption
Investigate critical community facilities, such as County administrative offices, shelters (non-school buildings), fire stations and police stations, to evaluate their resistance to flood and wind hazards.	H	Flood, hurricane, Tornado, Severe Storm	1,2,4 / B.1-B6, C.1-C.4, D.1-D.4	Emergency ManagemenV In progress	VDEM	2 Years after Plan adoption
Prioritize facilities in known hazard areas (e.g., floodplains). Acquire, remediate, elevate repetitive loss properties	H	Flood	1,4/ C.1-C.4, D.1-D.4	Emergency ManagemenV In progress	VDEM	Annually during this 5 year Plan update cycle
Identify program of corrective actions to improve stormwater systems' capacity to handle major rain events.	L	Flood	1,3 / B3-B.5, D.1, D2	Planning/ In progress	Locality, VDEM	1 year after Plan adoption
Investigate, develop, or enhance Reverse 911 system or other public notification system.	H	All	5, 6 / A.1, A5, D.1-D.4	Emergency ManagemenV In progress	VDEM	2 years after Plan adoption

Continue to enforce zoning and building codes to prevent/control construction within the floodplain.	M	Flood	3 / B.1-B.2, C.2, D.1	Planning/ In progress	Locality	1 year after Plan adoption
Identify and protect critical recharge zones in high risk areas.	M	Flood	3 / B.2	Planning/ In progress	Locality	2 years after Plan Adoption
Work with the Virginia Department of Forestry to review local zoning and subdivision ordinances to identify areas to include wildfire mitigation principles.	L	Wildfires	3 / B.2	Planning, Emergency ManagemenV In progress	Locality, DOF, VDEM	5 years after Plan adoption
Work with mobile home parks to construct community wind shelters or to identify and publicize nearby shelters for residents.	L	Hurricane, Tornados, Storms, Snow	5, 6 / A.1-A.6, D.1-D.4	Planning, Emergency ManagemenV In progress	VDEM	3 years after Plan adoption
Inspect and clear debris from stormwater drainage system. Encourage VDOT to execute this strategy if needed.	L	Flood, hurricane, Tornado, Severe Storm, Snow, Ice, Landslide	2, 4 / C.2, D.1-D.4	Emergency ManagemenV In progress	VDEM, VDOT	Annually during the Plan update five year cycle

Frederick County and Towns of Middletown and Stephen City (in addition to the regional strategies have these locality-specific strategies):

Action Plan to Implement Strategies						
Frederick County, Town of Middletown, Town of Stephen City						
Mitigation Action	Priority	Hazard(s)	Goals (1-6) / Actions (A-D)	Responsible Dept / Status	Funding Source	Target Completion Date
Conduct public education on the principles of "sheltering in place."	M	All	6 / A.1-A.6	Planning/ In progress	VDEM	1 Year after adoption of Plan; Action begun, continue
Identify and educate homeowners in flood-prone areas about flood insurance and floodplain mitigation measures.	H	All	2 / D.1, D.D.2, D.3, D.4	Emergency ManagemenV In progress	VDEM	Ongoing and in progress, continue

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Work with the Virginia Department of Forestry to implement the FIREWISE program in County and Towns.	M	Wildfires	5, 6 / A.1-A.6, D.1-D.3	Planning/ In progress	VDEM	2 years after Plan Adoption; initiated
Conduct emergency preparedness education campaign targeted at residents and business within dam inundation zones.	H	Dam Safety, Flood	1, 2, 4 / A.1-A.6, D.1-D.4	Emergency Management/ In progress	VDEM	Ongoing and in progress, continue
Work with local home improvement stores to provide workshops to residents on mitigation techniques.	M	ALL	5, 6 / A.1-A.6	Emergency Management/ In progress	VDEM	Ongoing and in progress, continue
Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day).	H	All	2 / D.1, D.2, D.3, D.4	Emergency Management / In progress	VDEM	Ongoing and in progress, continue
Work with the National Weather Service to promote the Turn Around, Don't Drown public education campaign.	M	Flood	5, 6 / A.1 -A.6, B.2	Emergency Management/ In progress	VDEM, Locality	Ongoing, continue progress
Develop flu annex for continuity of operations plans.	L	All	3 / D.4	Emergency Management/ In progress	Locality, VDH	Ongoing, continue progress
Develop debris management plan.	M	Flood, Storms, Snow, Ice, Hurricane, Tornado	1 5 / C.1-C.4, D.1-D.4	Emergency Management/ In progress	VDEM, Locality	Ongoing, continue progress
Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury and or property damage.	H	All	1,2 / C.1C.4, D.1D.4	GIS, Emergency Management/ In progress	Locality, VDEM	2 years after Plan adoption; in progress and ongoing
Identify training opportunities for staff to enhance their ability to use GIS for emergency management needs.	M	All	1,2 / C.1C.4, D.1D.4	GIS, Emergency Management/ In progress	Locality	Completed. Ongoing maintenance in progress throughout planning cycle
Investigate all primary and secondary schools to evaluate their resistance to all natural hazards. Prioritize the schools that are used as community shelters.	H	All	All	Emergency Management/ In progress	Locality, VDEM	Ongoing. Continue progress throughout planning cycle

Investigate critical community facilities, such as County administrative offices, shelters (non-school buildings), fire stations and police stations, to evaluate their resistance to flood and wind hazards.	H	All	All	Emergency Management/ In progress	Locality, VDEM	Ongoing, Continue progress throughout planning cycle
Prioritize facilities in known hazard areas (e.g. floodplains).	M	Flood	1 4 / C.1-C.4, D.I	Emergency Management/ In progress	bcality	Ongoing, continue to verify facilities and locations
Link structure value data with tax parcel GIS database to increase accuracy of loss estimates.	M	All	1 2 / C.1C4, D.1D.4	GIS, Emergency Management/ In progress	bcality	Completed Ongoing maintenance in progress throughout planning cycle
Review and revise, if needed, existing Subdivision Ordinances to include hazard mitigation-related development criteria in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.	M	All	5 / 8.2	Planning/ In progress	bcality	Ongoing, Continue through 2 years after Plan adoption
Review and revise, if needed, local floodplain ordinances. Work with the state to coordinate a Community Assistance Visit to identify potential improvements or enhancements to existing floodplain management program.	H	Flood	3 / 8.2	Emergency Management with Planning/ In progress	locality	Ongoing, Continue through 2 years after Plan adoption
Encourage purchase of NOAA radios. Provide NOAA weather radios to public facilities.	H	All	All	Emergency Management/ In progress	VDEM	Ongoing, Continue until completion by 2 years after Plan adoption
Increase flood warning capabilities, particularly as they relate to dam failure.	H	Flood, Dam Safety	1 2, 4, 5 / 8.1-8.5, D.1-D.4	Emergency Management/ In progress	locality, VDEM and DCR for infrastructure	Ongoing, Continue until completion by 3 years after Plan adoption
Investigate, develop, or enhance Reverse 911 system or other public notification system. Investigate possible funding sources.	H	All	All	Emergency Management/ In progress	bcality and VDEM	Ongoing, Continue through 2 years after Plan adoption

The Town of Stephens City has these strategies in addition to the County and two Towns' strategies listed above:

Action Plan to implement Strategies						
Town of Stephens City						
Mitigation Action	Priority	Hazard(s)	Goals (1-6) / Actions (A-O)	Responsible Dept / Status	Funding Source	Target Completion Date

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Conduct public education on the principles of "sheltering In place".	H	All	6 / D.1-D.4	Town and County Emergency management / In progress work with Schools and other shelters	VDEM	5 years from Plan adoption
Identify and educate homeowners in flood-prone areas about flood insurance and flood plain mitigation measures.	M	Flood	2, 6 / A.5 A.6, B.1-B.5 D.1-D.4	Town work with VDEM / In progress	VDEM	5 years from Plan adoption
Work with local home improvement mitigation techniques.	L	All	5, 6 / A.5, A.6, D.1-D.4	Town work with VDEM / In progress	VDEM, Lowes or other hardware corporation with a safety program	5 years from Plan adoption
Develop debris management plan.	H	All	5 / C.3 D.1-D.4	Town Staff / In progress	Town and or VDEM	5 years from Plan adoption
Investigate critical community facilities, such as the town office; identify shelters (non-school buildings), fire and police stations, to evaluate their resistance to flood and wind hazards. Prioritize facilities in known hazard areas (e.g., floodplains)	M	All	All Goals / All Actions	Town work with County Emergency Management and VDEM	VDEM	5 years from Plan adoption
Review and revise, if needed, local floodplain ordinances. Work with the state to coordinate a Community Assistance Visit to identify potential improvements or enhancements to existing floodplain management program.	L	Flood	2, 6 / A.5, A.6, B.1-B.5 D.1-D.4	Town work with VDEM / In progress	VDEM	5 years from Plan adoption
Identify key critical facilities and provide necessary electrical hook-up, wiring, and switches for emergency generators.	H	All	4 / C.1-C.4 D.1-D.4	Town work with VDEM / In progress	VDEM	5 years from Plan adoption
Investigate, develop, or enhance Reverse 911 system or other public notification system. Investigate possible funding sources.	H	All	All Goals / All Actions	Town work with County Emergency Management and VDEM	VDEM	5 years from Plan adoption

Page County and its Towns of Shenandoah, Luray, and Stanley have the following strategies in addition to the regional strategies:

Action Plan to Implement Strategies						
Page County, Town of Luray, Town of Shenandoah, Town of Stanley						
Mitigation Action	Priority	Hazard(a)	Goals (1-6)/ Actions(A-D)	Responsible Dept/ Status	Funding Source	Target Completion Date
Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g. hurricane preparedness week, winter weather awareness day, etc.).	H	All	All	Communications, Emergency Management / In progress	VDEM	2 years from Plan Adoption
Create a multi-level education brochure and program that would be taught on different levels with regards to education within the school system as well as targeting a brochure for the residents throughout the county.	L (Changed from H)	All	1, 6 / A.1-A.6 D.1-D.4	Communications, Emergency Management / In progress	VDEM	Annually, throughout 5 year cycle.
Create informational flyer to be handed out at the time of building permits are applied for with regard to building weather resistant homes. This flyer would be targeted to contractors and developers in a way to enhance their building project.	H	All	61 A.1-A6 D.1-D4	Emergency Management/ In progress	VDEM	1 year from Plan adoption
Identify need for Back-Up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfalls identified.	H	All	4 / C.1-C.4, D.1-D.4	Emergency Management/ In progress	VDEM	2 years from Plan Adoption
Procure and install backup generators for lift stations for wastewater treatment plants throughout the region	H	All	1 4 / C.1-4 D.1-4	Emergency Management	VDEM	1 year from Plan adoption
Coordinate with the state to update and digitize community Flood Insurance Rate Maps FIRMs).	H	Floods	1/B.1-B.5	Emergency Management/ In progress or initiated (completed in Luray)	VDEM	3 years from Plan adoption.

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Install additional iflows in rivers throughout the region and update the digital readouts to facilitate transfer of data fanaloa updatesl	H	Floods	1 / C.2 0.1-0.4	Emergency ManagemenV in progress or initiated	VOEM, USGS	2 years from Plan Adootion
Encourage public and private water conservation plans, including consideration of rainwater catchment system or other low impact development techniQues.	Drouaht	Changed from M to L	3/B.1-B.5	Emergency management or Town staff. In progress for all, completed in progress for all, completed in Luray and Stanlev.	VOEM	5 years from Plan adoption
Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FIRMs).	Medium changed to Hioh	All	1 2/B.3-B.5	Emergency Management /In progress in all, completed in Lurav	VOEM	2 years from Plan Adoolion
Evaluate properties within the floodplain for possible relocation and/or buy out. In particular, target FEMA's Repetitive Loss Properties throughout the Page Valley for possible relocation and/or buy out	H	Flood	4 / C.1-C.4, 0.1-0.4	Emergency managemenV in progress for all Towns and Countv	VOEM	3years from adoption of Plan
EYaltiale_al Fisl1reads aAd IFAplaFAeAl FAiligalieA mea6tlf96 (e.g. ele-1alieA, Fe desigA) WeFI1 4ilR. \IQOT as Reeded. *(Revised)Replace with:* Inspect and clear debris from stonnwater drainage system. Encourage VOOT to execute this strategy if needed. Maintain bridges vear1v	H	All	4 / C.1-C.4, 0.1-0.4	Emergency management, County and all Towns but Luray work with VDOT (Luray complete with Town staff) / In oroaress	VOEM, VOOT	Annually throughout 5 vear cvcle

Initiate discussions with public/private utility companies to discuss incorporating mitigation measures into new and pre-existing development and infrastructure repairs. Options include: anchoring heavy equipment such as electrical transformers mounted on poles using additional straps and braces; reducing camber in overhead transmission lines; and providing cover for exposed utilities	L	All	4 / D.1-D4	Emergency Management, Town staff / In progress	VDEM, Public Utilities	Complete by 4 years of Plan adoption
Evaluate properties within the floodplain for possible relocation and/or buy out. In particular, target FEMA's Repetitive Loss Properties throughout the Page Valley for possible relocation and/or buy out.	H	Flood	1,4 / C.1-C.4, D.1-D.4	Emergency Management, Town staff / In progress	VDEM	Annually throughout 5 year cycle of Plan update.
Work with land trusts to facilitate purchase of land.	H	All	All	Emergency Management, Town/In progress	VDEM, Valley Conservation Council, land trusts	Annually throughout 5 year cycle of Plan update.
Implement a program to seal and vent or raise sewer system components (i.e. manhole covers that are located in the 100-year floodplain or other areas identified as highly erodible floodplain.	H	All	4 / D.1-D.4	Emergency management, County and all Towns but Luray work with VDOT (Luray complete with Town staff) / in progress	VDEM, VDOT	Annually throughout 5 year cycle.
Integrate the jurisdiction's mitigation plan into current capital improvement plans to ensure that development does not encroach on known hazard areas.	L	All	3 / A.1-A.6 B.1-B.3	Emergency Management, Town staff / In progress	VDEM	Completed throughout and by end of 5 year Plan update cycle
Investigate all primary and secondary schools to evaluate their resistance to all natural hazards. Prioritize the schools that are used as community shelters	L	All	5,6 / A.1-A.6, D.1-D.4	Emergency Management, Town staff / In progress	VDEM	Completed throughout and by end of 5 year Plan update cycle

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Link structure value data with tax parcel GIS database to hcrease accuracy of loss estimates.	L	All	2 / B.1-B5	Emergency Management work with GIS and Town Staff	VDEM	Completed throughout and by end of 5 year Plan update cycle
Establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood-prone areas. Work with VDOT and other jurisdictions as needed.	H			Emergency Management. Planning Staff/ in progress	Localities. VDEM	Annually over next five years
PeRRially J!BFIRelle I;lagle BF 8ey See11ts kRl.s 11aF1le1llaF emoved due to liability issues.	M	-	-	Removed		
Staff Emergency Management Office, Public Works, Building hspections Office and/or Planning and Zoning Office at adequate levels as detennined by the county based upon population demographics with regard to density and hazardous risks.	M	All	5 / B.1-B.4	Emergency Management, Planning Staff/ in progress	Localities, VDEM	Annually over next five years
Work with the Department of Forestry to implement the FIREWISE program in Page County.	M	Fire	5,6 / A. 1-A.6, D.1-0.4	Emergency Management, Town Staff / In progress	VDEM DOF	4 years from Plan Adoption
GFealeFBIRIRII e1I1leFI1IRlles eF Ele11aF1meRlal slali eR llevk iR F9EII6B Razar4 FeEIl6li9R wllliRe Elaily alliIYilies el ge-feFRFRaRI (RaYlsaEI BREI lRBSFJBFaleEI iR	M	-	Removed	hcluded and reworded in Page County and all 3 Towns' strategies		
Ensure all localities within the planning region have FIRM flood maps up to date	H	Flood	1 2 /B.1-B4	GIS, Planning/ Inprogress	VDEM	1 year from Plan Adoption

Work with localities to improve documentation of flooding events and impacts to transportation routes.	H	Floods, Storms, Snow, Hurricane, Tornado	1,2,4/A.3,A.5,B.1-B.4, C.1-4, D.1-4	Emergency Management, Transportation Planning (as available) / In progress	VDEM	2 years from Plan Adoption
Greale e1111eF11 1Rilie6 a0e lie-" iRleF Ele11aFIFReRlal 6lal eaR iRIFeli.1ee llalaFEI flKHletieR ¥.iilliRle Elaily aeli\iie6, 11reee66e6 BREI ...1ReleR6	L	Removed, completed and reworded into above				
The County will consider participating in the StormReady Program sponsored by the National Weather Service.	L	Thunder storms, hurricane, tornado, winter storms	5,6/B.1, A.2, A.5, A.6	Emergency Management work with Towns and NWS	VDEM	Completed by 5 years from Plan adoption
Pre11e6e a FRere re61Fellus i: 1eeE111leR OFEIIRaRellalwill elleeli"ely eliFRiRale &f FRIRIFRIOle R9¥ Eleuele11FReRI ...uulR ile HeeE111leR, leelllay, aREI lleell Base.	L	Removed, completed and reworded into above				

Town of Luray in Page County has Hazard Mitigation strategies listed for Page County plus these strategies listed below:

Action Plan to Implement Strategies Town of Luray

Mitigation Action	Priority	Hazard(a)	Goals (1-6)/ Actions(A-D)	Responsible Dept/ Status	Funding Source	Target Completion Date
We 1 fi1 leaal FRellia elffleis iRerease a•Hi8FeR966 el RalYFal llaOIBFEIS BREI aeli•ely /FeFRale BREI 11aF1lei11ele iR 6ea6eRal llaaFEI awaFeRess llayseF 1ieel Ee g., WiRleF	H			Removed specific to Luray and placed as Page County and all 3 Town strategy, In progress		
Greale e1111aF11 1Rilias as te llew iRleF Ele11aFIFReRlal slali eaR iRlrelli.1ee llaaFEI flKHletieR 1lliRe Elaily aeliYilies, 11reeesses BREI YReleRS	M			Removed specific to Luray and revised to staff capacity strategy for Page County and all 3 Town strategy, In progress		
IEleRli#y Reell er eael1o111 qeReFalere eeFRFRYRiaalieRS, aREller "ellieles al eFiies/111 1elie laeillie6, Qe•.•ele11 FReaR aillIresEle slleilall illeRileEl.	H			Removed specific to Luray and placed as Page County and all 3 Town strategy, In progress		
IRegFalde y1FidElieleR'6 FRiigalieR 11laR iRle e1o1FFeRl aa11iel improvement plans to ensure that	L			Removed specific to Luray and placed as Page County and all 3 Town strategy, In		

development does not encroach on known hazard areas.				progress		
Sia# mef!leRey MaRagemeRI Q#iee, FlllllieWeFl1s. 8lilEliRg IRSJleulleRS Q#iee aREIJeF FlaRRRg BRE..leRiRg Q#iee al aEleElli&le leYels as EleleFmiReEl llyRe ee!IR'llaseEl llJl9R 11eJllllalieR EiemegFBJIRies YA1A FeljBFEl e EleRsilyBREI Ra<laFElells Fislts.	L			Removed specific to Luray and placed as Page County and all 3 Town strategy. In oroaress		
Wor1< with the County of Page Emergency Operations Center for better Hawksbill monitorina abilities.	M	Flood	1 2 1A.2, B.1 6 5	Town staff and County Emergency Management / In oroaress	VDEM	Annually throughout 5 year Plan update cycle or until comolete.
Provide training for Town Staff (Public Wor1<s, Police Departments) relating to hazards weather, disasters, flood zones and natural disasters.	H	All	All	Town staff and County Emergency Management / In oroaress	VDEM	Annually throughout 5 year Plan update cycle or until comolete.
Town to wor1< with Page County Emergency Operations Center to better provide reverse 911 calls to the public /citizens of Luray during hazardous natural events.	H	All	All	Town staff and County Emergency Management / In oroaress	VDEM	Annually throughout 5 year Plan update cycle or until comolete.
Wor1< with local real estate agents to ensure better provision of information (maps, etc.) to potential home buyers in areas of recognized floodprone zones within the Town of Luray. Locality would wor1< with County to ensure brochure is distributed to potential home buvers.	M	All	6 1 A.1-A.8, D 1 D 4	Town staff / In oroaress	VDEM	Completed by 3 years from Plan adootion.

Town of Shenandoah in Page County has these Hazard Mitigation strategies listed below in addition to the ones included in Page County:

Action Plan to Implement Strategies Town of Shenandoah						
Mitiaation Action	Prioritv	Hazard(s)	Goals (1 6)/ ActionsCA-0)	Responsible Dept/ Status	Funding Source	Target Completion Date
GFeale e1111eYRilies ale RewIRleF Ele11ameRlalsla# eaR IRIFeBllee RBDIBFG liiRiRRe Elaily aeli"ilies, JIFeeesses BRE YReIleRS.	H			Removed specific to Shenandoah Town and revised to staff capacity strategy for Page County and all 3 Town strategy. In proaress		

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lIUefl1•lill! lle OepaFlFRBRl el FeFesl •bimpleFRaRl lle FIREWISE FegFaFR R Page	L			Removed specific to Shenandoah Town and added as a strategy for Page County and all 3 Towns / In

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				progress		
Develop a link to the I-Flows database for the Town staff to access and use for stream levels	M	Flood	1,2/ C.1-C.4, D.1-D.4	Town, County Emergency Management / In progress	VDEM, USGS	Completed by 2 years from Plan adoption.
Change stream gauge outflow location. Develop on-line interaction to be notified of outflow upgrades.	M	Flood	1,2/C.1-C.4, D.1-D.4	Town, County Emergency Management / In progress	VDEM, USGS	Completed by 2 years from Plan adoption.
Create mar1<ers on bridges to determine flood and drought stages	H	Flood	1,2/C.C.4, D.1-D.4	Town, County Emergency Management / In progress	VDEM, USGS	Completed by 2 years from Plan adoption.
Develop a Notification Plan for water infrastructure in the event of failure of water system.	H	Flood	1,2/ C.C.4, D.1-D.4	Town, County Emergency Management / In progress	VDEM, USGS	Completed by 2 years from Plan adoption.
Designate an alternative location for Town Office in the event of a disaster, to ensure continuity of Town office functions.	H	All	All Goals/ All Actions	Town Staff / In progress	Locality, VDEM	Complete 2 years from Plan adoption
Ensure generators are in place, functional, with routine checks. Develop a generator maintenance program and record inspections in central location.	H	All	All	In progress and in Page County strategy	VDEM	Complete 4 years from Plan adoption
We ..lill'llesal meElia elllels (Aewis11aJ1eF, +v. FaElie "ellsiles. :Pl)leiAeFaase arraFeA966 el ABIljFal Ra Tellis				Removed specific to Shenandoah Town and added as a strategy for Page County and all 3 Towns / In progress		
Evaluate at-risk roads and implement mitigation measures in the event of a disaster. Wor1<with VDOT as appropriate. (Also revised and added as a County strategy for County and all 3 Towns with clear debris)	H	All	All Goals/	Town Staff / In progress	VDEM	Complete 4 years from Plan adoption

Town of Stanley in Page County has these Hazard Mitigation strategies listed below in addition to the Page County strategies:

Action Plan to Implement Strategies Town of Stanley

Mitigation Action	Priority	Hazard(s)	Goals (1-6)/ Actions(A-D)	Responsible Dept/ Status	Funding Source	Target Completion Date

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Greale lAleFl'AalieAal llvefe lle llaAded eYl al lldme el llYildiA!l 11eFl'Ai s are a1111iee BF•Nill!regaFd19 llYilBiAll wealReF FesislaAl llemes. +lii& lly9FweYld lle aFgeledle 99AlFael9F6 aAd ee\•eleJleF& iA a way leeAllaAedleiF				Removed specific to Stanley Town and added as a strategy for Page County and all 3 Towns / In oroaress		
GeeFdiAale •AIR lle slale YJldale aAEI eigillOle eemmYAily I"leedIA6YFaA99 Raia Maps	H	Flood	1/0. D.4	Removed specific to Stanley Town and added as a strategy for Page County, Town of Stanley, and Town of Shenandoah/ In oroaress	VDEM	Completion by 2 years after Plan adootion.
Implement and/or enhance a program to seal and vent or raise sewer system components (i.e. manhole covers that are located in the 100-year floodplain or other areas identified as highly probable floodinal.	H	All	4 / C.1-C.4, D.1-D.4	Town of Stanley, Page County / In progress (This is also a regional County and Page Town strategy, with words revised slightly to implement and orenhance)	VDEM	Completion by 2 years after Plan adontion.
Evaluate at risk roads and implement mitigation measures (e.g. elevation, re-design) Work with VDOT as needed. Develop mapping or GIS layer ofthese.	H	All	2/B.1 B.3,B.4	Town of Stanley, Page County / In progress (This is also a regional County and Page Town strategy, with words revised slightly to develop GIS laverl	VDEM	Completion by 2 years after Plan adootion.

Staff Provide Page County Emergency Operations Center Management Office, with staff from Public Works, Building Inspections Office and/or Planning and Zoning Office Department during local hazards events to provide damage reports critical to Town infrastructure at adequate levels as determined by the town based upon population demographics with regard to density and hazardous risks.	H	All	All Goals / All Actions	Town of Stanley, Page County / In progress (This is also a regional County and Page Town strateavl	VDEM	Completion by 5 years after Plan adootion
~~WeFI\\\14U1I Re OepaftmeRI el i;:eresliɏe jmplemeRI Re I;:1RIWISII pre¡FBFI IRRe~~	-	Fire		Removed specific to Stanley Town and added as a strategy for Page County and all 3 Towns / In proaress		
Establish flood level markers along bridges and other structures to indicate the rise al water levels along creeks and rivers in potential flood-prone areas. Work with VDOT and other jurisdictions as needed.	H	All	4 / A.2, D.1-0.4	Town of Stanley, County Emergency Management and VDOT / In progress. This strategy also in Page County and 3 Towns (except Luray) strateav	VDEM / VDOT	5 years from Plan adootion
~~FleleRlally paRReF 'II̶RS llagle eF 8ey SeelI$RRis~~	-			Removed from Page County and Towns due to liabilitv issues		
Work with Page County Emergency Operations Center to receive I-flow measurements / markings to alert when streams around town and near infrastructure are near floodina.	H	Flood	14 / A.1-A.6, B.1-B.5, 0.1-0.4	Town-0f Stanley work with County Emergency management and UNSGS,and VOEM	VDEM, USGS	3 years from adoption of Plan

Shenandoah County and its six Towns have these Hazard Mitigation strategies (in addition the Towns of Edinburg, Mount Jackson, and New Market have strategies from the 2007 Plan):

Action Plan to implement Strategies

Shenandoah County, Towns of Edinburg, Mt. Jackson, New Market, Strasburg, Toms Brook, and Woodstock

Mitigation Action	Priority	Hazard(s)	Goals(1-6)/ Actions(A-D)	Responsible Dept/Status	Funding Source	Target Completion Date
Create a Public Education Program within the public and private schools within the community that will provide disaster preparedness Information to the student bodies that can be utilized within their individual homes.	H	All	6 / A.1	Emergency ManagemenV In progress	All Localities	Completed, provide annual updates.
Consider participating in the StormReady program sponsored by the National Weather Service.	M	Storms, Hurricane, Tornado, Winter Storms	5 / A.2	Emergency ManagemenV In progress	All Localities	Initiated, to continue throughou1 3 years alter Plan adopted to completion
Distribute information packets to raise awareness regarding the risks present in the region and to provide disaster preparedness information.	M	All	5, 6 / A.3	Emergency ManagemenV In progress	All Localities	Initiated, to continue throughou1 3 years alter Plan adopted to completion
Create a knowledgeable group of speakers within the community that can be available to present programs regarding Emergency Management Principles and Concepts to groups within the community.	L (County hired PIO staff)	All	5, 6 / A.1-A.6	Emergency ManagemenV In progress	All Localities	Initiated, to continue throughou1 3 years alter Plan adopted to completion.
Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (e.g., hurricane preparedness week, winter weather awareness day).	L (County hired PIO staff)	All	5, 6 / A.1- A.6	Emergency ManagemenV In progress	All Localities	Initiated to continue throughou1 3 years alter Plan adopted to completion.
Identify need for back-up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfall identified.	H	All	All	Emergency ManagemenV In progress	VDEM	Ongoing through 5 years of Plan cycle or until complete.
Develop a comprehensive debris management plan as an annex to the Emergency Operations Plan.	H	All	3, 4 / B.1-B.6, D.1 - D.4	Locality, VDOT/ In progress	Locality, VDOT	In Progress to continue throughout planning cycle.
Coordinate with FEMA and the state to continue program of updating the community Flood Insurance Rate Maps (FIRMs) for selected tributaries of the North Fork of the Shenandoah River	H	All	1, 4 / B.3, C.1-C.4, D.1-D.4	Emergency ManagemenV In progress	VDEM	In progress, to continue throughout planning cycle or until completion whichever comes first.

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Encourage public and private water conservation plans, including consideration of rainwater catchment systems or other low impact development techniques.	M	Drought	3 / B.4, A.6	Emergency ManagemenV In progress	All Localities	Ordinance passed for water conservation measures during declared drought stages.
Incorporate mitigation principles into local emergency management and recoveryplans.	M	All	All	Emergency ManagemenV In progress	VDEM, Planning staff (as available)	Inprogress, continue through planning cycle.
Provide training opportunities to local zoning and building code officials in subject materials such as damage assessment and mitigation	L	All	5/ B.6	Emergency Management (Damage assessment courses offered annually/ In progress	Locality, VDOT	Inprogress, to continue throughout planning cycle.
Identify means to coordinate, collect and store damage assessment data in GIS format for each natural hazard event that causes death, injury and or property damage.	L	All	2, 3 / B.6	Emergency Management. GIS as available/ In progress	Locality, VDOT	In progress, to continue throughout process.
Identify key critical facilities and provide necessary electrical hook-up, wiring, and switches for emergency generators.	H	All	All	Emergency ManagemenV In progress	Locality	Ongoing, to continue throughout 5 year cycle.
Evaluate properties within the floodplain for possible elevation or acquisition. In particular, target FEMA's Repetitive Loss Properties throughout the County for possible elevation or acquisition. Work with land trusts to facilitate purchase of land	H	Flood	1, 4 / C.1-C.4, D.1-D.4	Emergency ManagemenV In progress	Locality, VDEM	Ongoing to completion by 4 years after Plan adoption
Evaluate at risk roads and implement mitigation measures (e.g. elevation, re-design). Work with VDOT as needed.	L	Flood	2, 5/ B.1-B.5	Emergency Management, Locality intern with VDOT; also devices to measure rainflow for citizens/ In progress	Locality, VDOT	Ongoing, through completion by 4 years after Plan adoption.
Inspect and clear debris from stormwater drainage system. Encourage VDOT to execute this strategy if needed	H	All	4 / D.1-Dd.4	Emergency Management and VDOT/ In progress	VDOT	Ongoing, through completion by 4 years after Plan adoption.
Identify existing flood-prone structures that may benefit from mitigation measures such as elevation or flood-proofing techniques.	L	Flood	1, 4 / C.1-C.4, D.1-D.4	Emergency ManagemenV In progress	Locality	Ongoing, through completion 2 years after Plan adoption.
Develop Reverse 911 system or other public notification system	H	All	All	Management Completed/ In progress	Locality	Annual updates of new properties to database.
Establish flood level markers along bridges and other structures to indicate the rise of water levels along creeks and rivers in potential flood-prone areas.	M	Flood	1, 4 / D.1-D4	Emergency ManagemenV In progress	Locality	In progress for County and Towns, continue until completion or 3 years after Plan adoption.

Wor1< with VDOT and other jurisdictions as needed. (Possible partnering with Eagle Scout projects.)	M	All	All	Locality/ in progress	Locality (as desirous of project)	No status, to continue throughout 5 year planning cycle.
Continue to administer building and zoning regulations to insure proper development within flood crone areas.	M	Flood	3 / B.1-B.5	Planning and Zoning complete for flood/ In progress	Locality	Completed, annual update as needed.
Wor1< with the Virginia Department of Forestry to implement the FIREWISE program in Shenandoah County.	M	Wildfires	5, 6 / D.4	Emergency Management, DOF/ In progress	OOF, VDEM	County and Towns wor1< closely with Firewise and will continue to do so.

The Town of Edinburg has these strategies in addition to the County and all six Towns' strategies listed above:

Action Plan to implement Strategies

Towns of Edinburg

Mitigation Action	Priority	Hazard(s)	Goals (1-8)/ ActionsCA-DI	Responsible Dept / Status	Funding Source	Target Completion Date
Public notification of winter and severe storm information	H	Winter Storm, Severe Thunderstorm	6/ D.1-D.4	Town and County Emergency management / Inorogress	County, VDEM	5 years from Plan adootion
Create continuity of operations plan for town utilities and services.	H	All	All Goals/All Actions	Town public utilities staff wor1< with County emergency management / In progress	County, Town of Edinburg, and VDEM	5 years from Plan adoption
Install backup generator for water treatment plant and Well #1	H	All	4 / D.1-D.4	In regional County and Town strategies / Town staff wor1< with County Emergency Management	VDEM	5 years from Plan addition
Continue support of the Virginia Department of Forestry's FIREWISE program	L	Fire	5, 6/A.1-A.6, B.1-B.5, D.1-D.4	Town wor1< with County Emergency management and OOF	VDEM, DOF	Throughout 5 years of Plan update

The Town of Mount Jackson has these strategies in addition to the County and all six Towns' strategies listed above:

Action Plan to implement Strategies

Town of Mt Jackson

Mitigation Action	Priority	Hazard(s)	Goals C1 6I/ Actions(A-D)	Responsible Dept / Status	Funding Source	Target Completion Date
Work with local media outlets to increase awareness of natural hazards. Implement seasonal hazard awareness weeks or days (i.e., hurricane preparedness week, winter weather awareness davl.	H	All	5, 6 / A.1-A.6, D.1-D.4	Town and County Emergency management / In progress work with NWS	County, VDEM	5 years from Plan adootion
Conduct public education on the principles of "shelter in place".	H	All	6 / D.1-D.4	Town and County Emergency management / Inprogress work with Schools and other shelters	VDEM	5 years from Plan adootion
Identify need for back-up generators, communications, and/or vehicles at critical public facilities. Develop means to address the shortfall identified.	H	All	All Goals / All Actions	Town and County Emergency Management / Inoroaress	VDEM	5 years from Plan adootion
Qe.,rele laA feF seAtiA1:1lity ef e elatieAs laA iAe·JeAtef	g			Removed, comDleted		
Propose a more restrictive floodplain ordinance that will effectively eliminate or minimize development within the floodplain, floodway, and flood base.	H	Flood	1,3/B.1-B.5, D.1-D.4	Town Staff / In oroaress	Town of Mt Jackson and or VDEM	5 years from Plan adootion
Develop a comprehensive debris management plan as an annex to the Emergency Ooerations Plan.	H	All	5 / C.3 D.1-D.4	Town Staff / In oroaress	Town of Mt Jackson and or VDEM	5 years from Plan adootion
Continue support of the Virginia Department of Forestry's FIREWISE proaram.	M	Fire	5, 6 / A.1-A.6, B.1-B.5, D.1-D.4	Town work with County Emergency management and DOF	VDEM, DOF	Throughout 5 years of Plan uodate.

The Town of New Market has these strategies in addition to the County and all six Towns' strategies listed above:

Action Plan to implement Strategies

Town of New Market

Mitigation Action	Priority	Hazard(s)	Goals (1-6) / Actions(A-D)	Responsible Dept / Status	Funding Source	Target Completion Date
Design an interactive, animated computer program that describes the sources of inflow and infiltration and the role citizens play in reducing the problem.	H	Flood	1, 5, 6 / B.1-B.5, D.1-D.4	Town working with County Emergency Manager / In progress	VDEM, USGS	5 years from date of Plan adoption
Provide up-to-date current weather information through local media on town's website	H	All	6 / a5 A.6	Town working with County Emergency Manager / In progress	Town, VDEM	Current in progress to be maintained and enhanced by 5 years from date of Plan adoption
Secure town water sources (wells) through the installation of perimeter fencing and electronic access	H	All	4 / C.2, C.3, C4, D.1-4	Town working with County Emergency Manager / In progress	Town, VDEM, DEQ-VDH Wellhead protection program	5 years from date of Plan adoption
Work with the Department of Forestry to implement the FIREWISE program in Page County.	M	Fire	5, 6 / A.1-A.6, B.1-B.5, D.1-D.4	Town work with County Emergency management and DOF	VDEM, DOF	Throughout 5 years of Plan update

Warren County Hazard Mitigation Strategies include:

Action Plan to implement Strategies

Warren County

Mitigation Action	Priority	Hazard(s)	Goals (1-6) / Actions(A-D)	Responsible Dept / Status	Funding Source	Target Completion Date
Create training opportunities for departmental staff on how to introduce hazard reduction within the daily activities of government.	H	All	All	Emergency Management M. Viggiano/ In progress ongoing	Locality	5 years from adoption of this Plan
Work with local media outlets to increase awareness of natural hazards and actively promote and participate in seasonal hazard awareness weeks or days.	H	All	All	Emergency Management M. Viggiano/ In progress ongoing	Locality	5 years from adoption of this Plan
Create a pre-disaster family response plan to distribute to members of the community with shelter designation	M	All	All	Emergency Management M. Viggiano/ In progress ongoing	Locality	5 years from adoption of this Plan

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Expand the local emergency management committee to include private sector organizations.	L	All	All	Emergency Management M. Viggiano/ Inprogress ongoing / Continuing to meet with them	Locality	5 years from adoption of this Plan
Work with local home improvement stores, local media outlets and other local agencies to provide workshops to residents on mitigation techniques.	L	All	All	Emergency Management M. Viggiano/ Not initiated yet	Locality	5 years from adoption of this Plan
Integrate the jurisdiction's mitigation plan into the current Capital Improvements Plan, as well as researching other funding opportunities.	H	All	All	T Logan, Planning DepV In progress	Locality	5 years from adoption of this Plan.
Review the County's existing floodplain ordinance to ensure that it is meeting local needs.	M	Flood	3/ B.2-B.5	T. Logan, Planning DepV Completed. To review annually for any updates	Locality	5 years throughout cycle from time of adoption of this Plan
Coordinate with the state to update and digitize community Flood Insurance Rate Maps (FIRMs).	M	Flood	1, 2/ C.1-C.4, D.1-D.4	T. Logan, Planning DepV Completed. To review annually for any updates	VDEM	5 years throughout cycle from time of adoption of this Plan
Incorporate the hazard mitigation plan goals and strategies into the County's Comprehensive Plan.	M	All	All	T. Logan, Planning DepV Inprogress	Locality	1 year from adoption of this Plan and annually as needed.
Provide training opportunities to local zoning and building code enforcement staff and educate them on damage assessment, mitigation techniques, and other related topics.	L	All	All	Building Inspection/ In progress	Building Inspection, David Beahm	5 years from adoption of this Plan
Review critical community facilities such as County administrative offices, school buildings, fire stations and police stations to evaluate their resistance to natural and manmade hazards.	H	All	All	Emergency Management R. Mabie/ Inprogress	Locality, Emergency Management	5 years from adoption of this Plan
Identify existing flood prone structures that may benefit from mitigation measures such as elevation or flood-proofing techniques.	L	Flood	All	T. Logan, Planning DepartmenV not started	Locality	5 years from adoption of this Plan
Inspect and clear debris from stormwater drainage systems. Encourage VDOT, Sanitary Districts, and Property Owner Associations to execute this strategy.	L	All	All	Emergency Management R. Mabie/ Not started	Locality, VDOT	5 years from adoption of this Plan
Based upon the community's needs and associated risks, staff the Emergency Management Office, Fire and Rescue, Law Enforcement, Parks and Recreation, Building Inspections Department, and Planning and Zoning at adequate levels as determined by County Administration.	H	All	5,6 / B.1-B.6	Emergency Management and Doug Stanley/ Completed	Locality	Completed, to be reviewed annually

Continue support of the Virginia Department of Forestry's FIREWISE prooram.	M	Wildfires	All	Emergency Management, R. Mabie/ Inprogress	Locality, VDOF	5 years from adoption of this Plan

Town of Front Royal Hazard Mitigation strategies are listed below:

NSV R1mlonal Action Plan tOm Dlament R8alonlll Sm.t.alea

Mitigation Action	Prioritv	Hazard(a)	Goals (1-6)1 ActionslA-DI	Responsible Dept/ Status	Funding Source	Target Completion Date
Utilize opportunities provided by Warren County Emergency Management Department for Town staff on how to introduce hazard reduction within the daily activities of government. This to include a program so key personnel and Department Heads receive basic training in emergency response, such as ICS certifications	H	All	5,6 /A.5, D.1-D.4	Town administration / In progress, initiated and onooino	Town and County	By 5 years of addition of this Plan
Coordinate with Warren County Emergency Management Department to work with local media ou11etstoincrease awareness of natural hazards and actively promote and participate in seasonal hazard awareness days or weeks. Includes activities during Health & Wellness Expo annually as schools reauest	H	All	5 6/ A.5 A.6	Town administration / Inprogress, Initiatedand onaoina	Town and County	By 5 years of addition of this Plan
Create a pre-disaster family response plan to distribu1e to members of the community.	M	All	5,6 / A.3, A.4 A.5A.6	Town administration and County Emergency Management / Inprogress, Initiated and onaoino	Town and County	By 5 years of addition of this Plan
Work with local home improvement stores, local media outlets and other local agencies to provide workshops to residents on mitioation techniaues.	L	All	5, 6 / A.2, A.3, A.6 D.1-D.4	Town administration and County Emergency Management / Into started	Town and County	By 5 years of addition of this Plan
Develop additional GIS layers and training opportunities for Town staff to increase their knowledge and ability to use GIS for emergency manaaement	H	All	2/A.3 B.5	Town Planning Department and GISI Inprooress	Town	By 5 years of addition of this Plan

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Coordinate with FEMA and Virginia OCR to continue program of updating and digitizing the community FIRMS	H	Flood	1, 2 / A.1-A.4, B.3 D.1-D.4	Town Planning Department and GISI Completed, updated and ongoing as needed in progress	Town	Completed, annual updates as needed
Provide training opportunities to local zoning and building code enforcement staff and educate them on damage assessment, mitigation techniques, and other related topics	M	All	5, 6 / A.1-A.6, B.4 B.5	Town DES, Energy Services, and Planning Staff / in progress	Town	By 5 years of addition of this Plan
Integrate the jurisdiction's mitigation plan into the current Capital Improvements Plan, as well as researching other funding opportunities.	M	All	3 / B.2, B.3	Town Manager / Not started yet	Town	By 5 years of addition of this Plan
Continue comprehensive inspection and debris removal program for storm water drainage system	H	All	4 / D.1-D.4	Town Environmental Services (J.Hannigan)/ In progress and ongoing	Town	Annually throughout 5 year update of this Plan from time of adoption
Identify existing flood prone structures that may benefit from mitigation measures such as elevation or flood-proofing techniques . Research grants to fund mitigation implementation	M	Flood	1, 4 / A.3, C.1-C.4	Town Director of Planning / Ongoing, in progress	Town	Annually throughout 5 year update of this Plan from time of adoption
Based upon the community's needs and associated risks, staff Emergency Management, Fire and Rescue, Law Enforcement, Parks and Recreation Building Inspections Department, and Planning and Zoning at adequate levels as determined by Town Administration	M	All	5 6/ B.1-B.5	Town Manager /In progress	Town	Annually throughout 5 year update of this Plan from time of adoption
Continue support of the Virginia Department of Forestry's FIREWISE program	Medium changed to low priority due to low applicability in Town	Fire	5,6/A.1-A.6, D.1-D4	Town staff with County Emergency Management and DOF/ in progress limited applicability	DOF and County	Throughout 5 year update of Plan from time of adoption

Review and develop land development ordinances that facilitate mitigation of hazards and responsiveness to emergencies during disasters	M	All	3/ A.1 B.1-B.5	Town planning Department / In progress, newly added	Town	By 5 years of addition of this Plan

City of Winchester Hazard Mitigation Strategies (in addition to the regional strategies):

Action Plan to implement Strategies						
Winchester City						
Mitigation Action	Priority	Hazard(s)	Goals (1-6) / Actions(A-D)	Responsible Dept / Status	Funding Source	Target Completion Date
Procure and install backup generators for lift stations for wastewater treatment plants	H	All	All	Emergency Management Initiated / In progress	VDEM	In progress to continue until completion or throughout the Plan reviewcycle.
Create an educational program and administer it throughout the community targeting residents within the City relating to all hazards including pandemic influenza.	H	All	3, 5, 6 / A.1, D.1-D.4	Emergency Management Initiated / In progress	Locality and VDH	In progress to continue all 5 years of planning cycle.
Create a local informational brochure and distribute the brochure throughout the community to better inform the community with regard to local emergency preparedness information	M	All	6 / A.1-A.6	Emergency Management Initiated / In progress	VDEM	In progress to continue all 5 years of planning cycle.
Create a Public Education Program within the public and private schools within the community that will provide disaster preparedness information to the student bodies that can be utilized within their individual homes.	M	All	1, 6 / A.1-A.6, D.1-D.4	Emergency Management Initiated / In progress	Locality, VDEM	In progress, to continue all 5 years of planning cycle.
Create a knowledgeable group of speakers within the community that can be available to present programs regarding Emergency Management Principles and Concepts to groups within the community.	L	All	6 / A.1-A.6	Emergency Management Initiated / In progress	VDEM	In progress, to continue all 5 years of planning cycle.
Conduct public education program throughout the City to residents and businesses relating to the "Shelter Assignments and Management."	L	All	6 / A.1-A.6	Emergency Management Initiated / In progress	VDEM	In progress, to continue all 5 years of planning cycle.
Consider participating in the StormReady Program sponsored by the National Weather Service.	L	Storms, Hurricane, Tornado, Winter Storm	5 / B.1-B.5	Emergency Management Initiated / In progress	VDEM, Locality	To complete by 4 years after Plan adoption

Develop plans that will provide continuity of operations for Public Safety and other related disciplines.	H	All	3/ B.1-B.5	Emergency Management Initiated / In progress	Locality, VDEM	In progress, to continue all 5 years of planning cycle.
Develop a comprehensive debris management plan as an annex to the Emergency Operations Plan.	H	All	All	Emergency Management Initiated/ In progress	VDEM, VDOT, Locality	To complete by 5 years of planning cycle.
Provide training opportunities to local zoning and building code officials in subject materials such as damage assessment and mitigation.	L	All	All	Emergency Management Initiated / In progress	Locality	To complete by 5 years of planning cycle.
Staff the Departments of Emergency Management, Public Safety and other associated departments at levels that are adequate to support Emergency Program.	L	All	All	Emergency Management Initiated / In progress	Locality, VDEM	To complete by 5 years of planning cycle.
Consider providing necessary electrical hook-ups including wiring and switches to allow ready access and connection of emergency generators to key critical oublic facilities.	M	All	All	Emergency Management Initiated / In progress	Locality, VDEM	In progress, to complete by 5 years of planning cycle.
Continue to develop and enhance the utilization of the Reverse 9-1-1 calling system.	M	All	All	Emergency Management Initiated/In progress	Locality, VDEM	In progress, to complete by 5 years of planning cvcle.
Continue work on the development and administration of Public Education Programs to better educate and prepare the community to deal with natural and man-made disasters.	M	All	All	Emergency Management Initiated / In progress	Locality, VDEM	In progress, to complete by 5 years of planning cycle.
Investigate all schools prioritizing those used as community shelters for resistance to all natural hazards.	L	All	All	Emergency Management Initiated / In progress	Locality, VDEM	In progress, to complete by 5 years of planning cycle.
Review and investigate all flood-prone areas within the 100 year floodplain area and incorporate mitigation measures where possible.	L	Flood	2/ B.1-B.5, C.1-C.4, D.1-D.4	Emergency Management Initiated / In progress	Locality, VDEM	In progress, to complete by 5 years of planning cycle.
Provide NOAA weather radios to all public facilities to permit ready access to weather issued weather statements.	L	All	All	Emergency Management Initiated / In progress	Locality, VDEM	In progress, to complete by 5 years of planning cvcle.
Create training opportunities for staff to increase their knowledge and ability to use GIS for emergency management.	H	All	All	Emergency Management, GIS Initiated / In progress	Locality, VDEM	In progress, to complete by 5 years of planning cycle.
Provide National Incident Management System and Incident Command System training to all emergency response personnel and other key support personnel.	H	All	All	Emergency Management Initiated / In progress	Locality, VDEM	In progress, to complete by 5 years of planning cycle.
Inspect and clear debris from storm water drainage systems to prevent property damage from localized flooding created by blocked inlets and transmission systems.	M	All	All	Emergency Management Initiated / In progress	Locality, VDEM, VDOT	In progress, to complete by 5 years of planning cycle.

Continue to administer building and zoning regulations to insure proper development within flood prone areas.	M	Flood	3 / B.1-B.5, D.1-D.4	Planning Initiated / In progress	Locality, VDEM	Ongoing, to continue through completion, or end of 5 year planning cycle.
Evaluate existing storm water systems to determine if it is adequate for existing and future flood hazards.	L	Flood	2 / D.1-D.4	Emergency Management Initiated / In progress	Locality, VDEM	Ongoing, to continue through completion, or end of 5 year planning cycle.
Review and modify the Emergency Operations Plan to better address the response to hazardous materials incidents by all emergency response personnel.	L	All	3 / C.1-C.4, D.1-D.4, B.2	Planning Initiated / In progress	Locality	ongoing, through 5 year planning cycle for completion.

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