



Chapter 5: Capability Assessment

I. Introduction

This portion of the plan assesses the current capacity of the communities of Northern Virginia to mitigate the effects of the natural hazards identified in Chapter 4 of the plan. As part of the 2010 update, the capability assessment section includes an update to the capability matrices found in Chapter 7 of the 2006 plan, as well as section reformatting. Perhaps the biggest change in the 2010 capability assessment section is the addition of the capabilities of the Towns that participated in this plan update. This assessment includes a comprehensive examination of the following local government capabilities:

- Administrative Capability;
- Technical Capability;
- Planning and Regulatory Capability; and
- Fiscal Capability.

The purpose of conducting a capability assessment is to determine the ability of a local jurisdiction to implement a comprehensive mitigation strategy, and to identify potential opportunities for establishing or enhancing specific mitigation policies, programs or projects.¹ As in any planning process, it is important to try to establish which goals, objectives, and/or actions are feasible, based on an understanding of the organizational capacity of those agencies or departments tasked with their implementation. A capability assessment helps to determine which mitigation actions are practical and likely to be implemented over time given a local government's planning and regulatory framework, level of administrative and technical support, amount of fiscal resources, and current political climate.

A capability assessment has two primary components: an inventory of a local jurisdiction's relevant plans, ordinances, or programs already in place; and an analysis of its capacity to carry them out. Careful examination of local capabilities will detect any existing gaps, shortfalls, or weaknesses with ongoing government activities that could hinder proposed mitigation activities and possibly exacerbate community hazard vulnerability. A capability assessment also highlights the positive mitigation measures already in place or being implemented at the local government level, which should continue to be supported and enhanced through future mitigation efforts.

For the 2010 update, each participating jurisdiction was given an opportunity to update their capability assessment information presented in the original 2006 plan. This effort included updating a Plans, Ordinances, and Programs table, Relevant Fiscal Resources table, and Relevant Staff and Personnel Resources table. Additionally, updates to the information presented below were conducted to better reflect the capabilities within the region as of 2010.

¹ While the Interim Final Rule for implementing the Disaster Mitigation Act of 2000 does not require a local capability assessment to be completed for local hazard mitigation plans, it is a critical step in developing a mitigation strategy that meets the needs of each jurisdiction while taking into account their own unique abilities. The Rule does state that a community's mitigation strategy should be "based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools" (44 CFR, Part 201.6(c)(3)).



II. Conducting the Capability Assessment

In order to facilitate an update of the 2006 inventory and analysis of local government capabilities throughout the Northern Virginia region, specific tables and components of the previous plan were distributed to the communities. These tables, which were completed by appropriate local government officials, requested information on a variety of “capability indicators” such as existing local plans, policies, programs, or ordinances that contribute to 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.

At a minimum, the updates to the 2006 information provided an extensive inventory of existing local plans, ordinances, programs, and resources in place or under development, in addition to their overall effect on hazard loss reduction. The update thereby not only helps to accurately assess each jurisdiction’s degree of local capability, but also serves as a good source of introspection for those jurisdictions that want to improve their capabilities as identified gaps, weaknesses, or conflicts can be recast as opportunities for specific actions to be proposed as part of the community’s mitigation strategy.

III. Capability Assessment Findings

The findings of the capability assessment are summarized in this Plan to provide insight into the relevant capacity of participating jurisdictions to implement hazard mitigation activities. All information is based upon the input provided by local government officials through the Capability Assessment Survey and during meetings of the Mitigation Advisory Committee. All completed survey questionnaires are available from the NVRC upon request.

A. Administrative and Technical Capability

1. Administrative

The ability of a local government to develop and implement mitigation projects, policies, and programs is directly tied to its ability to direct staff time and resources for that purpose. Administrative capability can be evaluated by determining how mitigation-related activities are assigned to local departments and if there are adequate personnel resources to complete these activities. The degree of intergovernmental coordination among departments will also affect administrative capability for the implementation and success of proposed mitigation activities.

The following table, originally developed under the 2006 Northern Virginia Hazard Mitigation plan, was updated as part of the 2010 planning process. A (Y) indicates that the given local staff member(s) is maintained through each particular jurisdiction’s local government resources. A (Y*) indicates that this capability is new as of the 2010 update. The Towns of Dumfries, Occoquan, and Quantico did not provide an update to the capability assessment.



Table 5.1. Administrative and Technical Capabilities

Jurisdiction	Planners with knowledge of land development and land management practices	Engineers or professionals trained in construction practices related to buildings and/or infrastructure	Planners or engineers with an understanding of natural and/or human-caused hazards	Emergency manager	Floodplain manager	Land surveyors	Scientist familiar with the hazards of the community	Staff with education or expertise to assess the community's vulnerability to hazards	Personnel skilled in Geographic Information Systems (GIS) and/or HAZUS ^{MH}	Resource development staff or grant writers
Alexandria, City of	Y	Y	Y	Y	Y	Y		Y	Y	Y
Arlington County	Y	Y	Y*	Y		Y	Y	Y	Y	
Clifton, Town of	Y*	Y*	Y*	Y*	Y*	Y*		Y*	Y*	Y*
Dumfries, Town of	Y	Y	Y	Y						Y
Fairfax County	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fairfax, City of	Y	Y	Y	Y*	Y	Y*		Y	Y	
Falls Church, City of	Y	Y	Y	Y	Y			Y	Y	Y
Haymarket, Town of	Y*	Y*								
Herndon, Town of	Y	Y	Y	Y	Y	Y*		Y*	Y	Y
Leesburg, Town of	Y	Y	Y*	Y*	Y*	Y*		Y*	Y*	Y*
Loudoun County	Y	Y	Y	Y	Y*	Y*	Y*	Y	Y	Y*
Manassas Park, City of	Y	Y	Y	Y	Y	Y		Y	Y	Y
Manassas, City of	Y	Y	Y		Y	Y		Y	Y	
Middleburg, Town of	Y*	Y*	Y*		Y*				Y*	
Occoquan, Town of										
Prince William County	Y	Y	Y	Y	Y	Y		Y	Y	Y
Purcellville, Town of	Y	Y	Y	Y	Y	Y		Y	Y	Y
Quantico, Town of										
Round Hill, Town of	Y*		Y*							
Vienna, Town of	Y	Y	Y	Y	Y	Y*		Y*	Y	Y*



As described previously, the planning area is comprised of four counties, five cities, and 11 towns. All of the counties in the planning area, Arlington County, Fairfax County, Loudoun County, and Prince William County, operate under a Board of Supervisors - County Administrator/Executive system. In this form of government, the elected board of supervisors appoints a county administrator who oversees daily operations of the county.

The Cities of Alexandria, Falls Church, Fairfax, Manassas, and Manassas Park operate under the City Council – City Manager system. The City Council is elected and it, in turn, appoints a City Manager who acts as the chief administrative officer and oversees daily business operations of the City.

The Towns of Clifton, Dumfries, Haymarket, Occoquan, and Round Hill operate under the Town Council – Mayor system; and the Towns of Herndon, Leesburg, Middleburg, Purcellville, and Vienna operate under a Town Council – Town Manager system, where the council appoints the Town Manager to act as the administrative officer.

Under the County Administrator, City, and Town Manager systems, each jurisdiction (with the exception of the Town of Quantico) has departments, councils, and boards that are responsible for the various functions of local government. The following table created for the 2010 update, highlights the departments in each jurisdiction that could facilitate the implementation of this hazard mitigation plan.

Table 5.2. Departments that could facilitate mitigation action implementation	
Jurisdiction	Departments
Alexandria, City of	Building and Fire Code Administration Fire Planning and Zoning Transportation and Environmental Services
Arlington County	Community Planning, Housing and Development Fire Department Environmental Services Office of Emergency Management
Clifton, Town of	Planning Commission
Dumfries, Town of	Town Council
Fairfax County	Office of Emergency Management Fire and Rescue Planning and Zoning Public Works and Environmental Services Water Authority
Fairfax, City of	Community Development and Planning Fire Department Public Works Police Department Utilities



Table 5.2. Departments that could facilitate mitigation action implementation	
Jurisdiction	Departments
Falls Church, City of	Development Services Environmental Services Public Safety
Haymarket, Town of	Planning Commission
Herndon, Town of	Public Safety Planning/Zoning
Leesburg, Town of	Planning and Zoning Police Department
Loudoun County	Fire, Rescue and Emergency Management Planning
Manassas Park, City of	Fire and Rescue Planning and Zoning Police Public Works
Manassas, City of	Emergency Preparedness Fire and Rescue Police Department Public Works Community Development
Middleburg, Town of	Zoning and Planning Police Department Engineering
Occoquan, Town of	Town Council
Prince William County	Fire and Rescue Planning Office Police Department Public Works
Purcellville, Town of	Planning Department Police Department Public Works
Quantico, Town of	None
Round Hill, Town of	Planning Commission
Vienna, Town of	Planning and Zoning Public Works Police

While exact responsibilities differ from jurisdiction to jurisdiction, the general duties of the departments highlighted in the table are described below.

The OEM is responsible for the mitigation, preparedness, response, and recovery operations that deal with both natural and man-made disaster events. Fire/EMS departments provide medical



aid and fire suppression at the scene of accidents and emergencies. These departments are often responsible for responding to hazardous materials incidents.

The Planning Department addresses land use planning. This department, depending on the jurisdiction, may enforce the NFIP requirements and other applicable local codes. Zoning also may be managed by the Planning Department or it may be a separate office.

In some jurisdictions, the Utilities Department oversees community water facilities or natural gas provisions. In others, the Public Works Department oversees the maintenance of infrastructure including roadways, sewer and stormwater facilities and the community's water treatment facilities. This department also may review new development plans, ensure compliance with environmental regulations, and work with the Virginia Department of Transportation on road issues. Depending on the jurisdiction, the Department of Public Works may enforce the NFIP requirements.

2. Technical Capability

Mitigation cuts across many disciplines. For a successful mitigation program, it is necessary to have a broad range of people involved with diverse backgrounds. These people include planners, engineers, building inspectors, emergency managers, floodplain managers, people familiar with GIS, and grant writers. Technical capability can generally be evaluated by assessing the level of knowledge and technical expertise of local government employees, such as personnel skilled in using GIS to analyze and assess community hazard vulnerability.

GIS systems can best be described as a set of tools (hardware, software, and people) used to collect, manage, analyze, and display spatially-referenced data. Many local governments are now incorporating GIS systems into their existing planning and management operations. GIS is invaluable in identifying areas vulnerable to hazards. Access to the Internet can facilitate plan development, public outreach, and project implementation.

The table below summarizes the technical capabilities of the jurisdictions. When provided, the specific department that has the technical capability is identified.



5.3. Technical Capabilities of each Jurisdiction

Jurisdiction	Land Use Planners	Civil or Building Engineers	Emergency manager	Floodplain manager	Staff familiar with hazards	GIS staff	Grant writers	Internet access?
Alexandria, City of	Planning & Zoning	Transportation & Environmental Services	Fire Department - Emergency Management	Transportation & Environmental Services	Fire Department - Emergency Management	Planning & Zoning	Planning & Zoning, City Administration	Yes
Arlington County	Community Planning	Environmental Services	Office of Emergency Management	Community Planning	Office of Emergency Management	Information Technology	County Administration, Police Department	Yes
Clifton, Town of	Planning Commission	Planning Commission	Public Safety	Planning Commission	Public Safety	Planning Commission	Planning Commission	Yes
Dumfries, Town of	Town Council	Town Council	Town Council	Town Council	Town Council	Town Council	Town Council	Yes
Fairfax County	Planning & Zoning	Public Works	Emergency Management	Planning and Zoning	Emergency Management	Information Technology	County Administration	Yes
Fairfax, City of	Community Development & Planning	Public Works	Public Safety - Emergency Management	Community Development & Planning	Community Development & Planning, Public Safety	Information Technology	City Administration	Yes
Falls Church, City of	Development Services	Environmental Services	Public Safety	Development Services	Development Services, Public Safety	Public Safety	Development Services	Yes
Haymarket, Town of	Planning Commission	Planning Commission	Planning Commission	Planning Commission	Planning Commission	Planning Commission	Town Council	Yes
Herndon, Town of	Planning Zoning	Planning & Zoning	Public Safety	Planning & Zoning	Public Safety	Public Safety	Town Council	Yes
Leesburg, Town of	Planning & Zoning	Planning & Zoning	Police Department	Planning & Zoning	Police Department	Police Department	Town Council	Yes
Loudoun County	Planning	Public Works	Fire, Rescue & Emergency Management	Planning	Fire, Rescue & Emergency Management	Fire, Rescue & Emergency Management	Planning	Yes



5.3. Technical Capabilities of each Jurisdiction

Jurisdiction	Land Use Planners	Civil or Building Engineers	Emergency manager	Floodplain manager	Staff familiar with hazards	GIS staff	Grant writers	Internet access?
Manassas Park, City of	Planning & Zoning	Public Works	Police Department	Planning & Zoning	Police, Fire & Rescue	Police, Fire & Rescue	Planning & Zoning, City Administration	Yes
Manassas, City of	Community Development	Public Works	Emergency Preparedness	Community Development, Emergency Preparedness	Public Safety	Emergency Preparedness	Community Development	Yes
Middleburg, Town of	Zoning & Planning	Engineering	Police Department	Zoning & Planning	Police Department	Police Department	Zoning & Planning	Yes
Occoquan, Town of	Town Council	Town Council	Town Council	Town Council	Town Council	Town Council	Town Council	Yes
Prince William County	Planning Office	Public Works	Fire & Rescue, Police Department	Planning Office	Fire & Rescue, Police Department	Fire & Rescue, Police Department	Planning Office	Yes
Purcellville, Town of	Planning Office	Public Works	Police Department	Planning Office	Police Department	Police Department	Planning Office	Yes
Quantico, Town of	Town Council	Town Council	Town Council	Town Council	Town Council	Town Council	Town Council	Yes
Round Hill, Town of	Planning and Zoning	Utility Department	Community Policing	Planning and Zoning	Town Council	Planning and Zoning	Planning and Zoning	Yes
Vienna, Town of	Planning & Zoning	Public Works	Police	Planning & Zoning	Police	Police	Planning & Zoning	Yes



B. Planning and Regulatory Capability

Planning and regulatory capability is based on the implementation of plans, ordinances, and programs that demonstrate a jurisdiction's commitment to guiding and managing growth, development, and redevelopment in a responsible manner, while maintaining the general welfare of the community. It includes emergency operations and mitigation planning, comprehensive land use planning, and transportation planning, in addition to the enforcement of zoning or subdivision ordinances and building codes that regulate how land is developed and structures are built, as well as protecting environmental, historic, and cultural resources in the community. Although some conflicts can arise, these planning initiatives generally present significant opportunities to integrate hazard mitigation principles and practices into the local decision making process.

The Planning and Regulatory capability assessment is designed to provide a general overview of the key planning and regulatory tools or programs in place or under development, along with their potential effect on loss reduction. This information helps identify opportunities to address existing planning and programmatic gaps, weaknesses, or conflicts with other initiatives, in addition to integrating the implementation of this plan with existing planning mechanisms where appropriate.

The table below provides an update to the 2006 Northern Virginia Hazard Mitigation Plan. It summarizes relevant local plans, ordinances, and programs already in place or under development for participating jurisdictions. A (Y) indicates that the given item is currently in place and being implemented by the local jurisdiction (or in some cases by the County on behalf of that jurisdiction), or that it is currently being developed for future implementation. A (Y*) indicates that capability is new as of the 2010 update.



Table 5.4. Local plans, ordinances and programs

Jurisdiction	Hazard Mitigation Plan	Comprehensive Land Use Plan	Floodplain Management Plan	Open Space Management Plan	Stormwater Management Plan	Flood Response Plan	Emergency Operations Plan	SARA Title III Plan	Radiological Emergency Plan	Continuity of Operations Plan	Evac Plan	Disaster Recovery Plan
Alexandria, City of	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Arlington County	Y	Y	Y*	Y	Y	Y*	Y	Y	Y	Y	Y	Y
Clifton, Town of	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*
Dumfries, Town of	Y	Y		Y	Y		Y				Y	
Fairfax County	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fairfax, City of	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Falls Church, City of	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Haymarket, Town of		Y*	Y*	Y*	Y*							
Herndon, Town of	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Leesburg, Town of	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Loudoun County	Y	Y	Y*	Y	Y	Y	Y	Y	Y*	Y	Y	Y
Manassas Park, City of	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Manassas, City of	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Middleburg, Town of	Y*	Y*	Y*	Y*	Y*	Y*		Y*	Y*	Y*		Y*
Occoquan, Town of												
Prince William County	Y	Y	Y				Y	Y	Y	Y	Y	
Purcellville, Town of	Y	Y	Y	Y	Y	Y	Y	Y	Y*	Y*	Y	Y
Quantico, Town of												
Round Hill, Town of		Y*			Y*							
Vienna, Town of	Y	Y	Y*	Y	Y	Y*	Y	Y	Y	Y	Y	Y*



Table 5.4. Local plans, ordinances and programs

Jurisdiction	Capital Improvements Plan	Economic Development Plan	Historic Preservation Plan	Flood Damage Prevention Ordinance	Zoning Ordinance	Subdivision Ordinance	Post-disaster Red/Rec. Ordinance	Building Code	Fire Code	National Flood Insurance Program	NFIP Community Rating System
Alexandria, City of	Y			Y	Y	Y		Y	Y	Y	Y
Arlington County	Y	Y	Y*	Y	Y	Y*		Y	Y	Y	Y
Clifton, Town of	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*
Dumfries, Town of	Y	Y		Y	Y	Y		Y	Y	Y	
Fairfax County	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fairfax, City of	Y	Y	Y	Y	Y	Y	Y*	Y	Y	Y	Y*
Falls Church, City of	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y*
Haymarket, Town of	Y*				Y*	Y*				Y*	
Herndon, Town of	Y	Y*	Y	Y	Y	Y	Y	Y	Y	Y	Y*
Leesburg, Town of	Y	Y	Y	Y	Y	Y		Y	Y	Y	
Loudoun County	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y
Manassas Park, City of	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Manassas, City of	Y	Y	Y	Y	Y	Y		Y	Y	Y	
Middleburg, Town of										Y	
Occoquan, Town of										Y	
Prince William County	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y
Purcellville, Town of	Y	Y	Y	Y	Y	Y		Y	Y	Y	
Quantico, Town of										Y	
Round Hill, Town of	Y*				Y*	Y*			Y*	Y*	
Vienna, Town of	Y	Y*	Y*	Y	Y	Y	Y*	Y	Y	Y	Y



A more detailed discussion on each jurisdiction’s planning and regulatory capability follows, along with the incorporation of additional information based on the narrative comments provided by local officials in response to the survey questionnaire. Copies of the completed surveys provide more detailed information on local capability, and can be obtained from the NVRC.

Emergency Management

Hazard mitigation is widely recognized as one of the four primary phases of emergency management. The three other phases include preparedness, response, and recovery. In reality each phase is interconnected with hazard mitigation as Figure 5.1 suggests. Opportunities to reduce potential losses through mitigation practices are most often implemented before disaster strikes, such as elevation of flood prone structures or through the continuous enforcement of policies that prevent and regulate development that is vulnerable to hazards because of its location, design, or other characteristics. Mitigation opportunities will also be presented during immediate preparedness or response activities (such as installing storm shutters in advance of a hurricane), and certainly during the long-term recovery and redevelopment process following a hazard event.



Planning for each phase is a critical part of a comprehensive emergency management program and a key to the successful implementation of hazard mitigation actions. As a result, the *Capability Assessment Survey* asked several questions across a range of emergency management plans in order to assess each jurisdiction’s willingness to plan and their level of technical planning proficiency.

Hazard Mitigation Plan: A hazard mitigation plan represents a community’s blueprint for how it intends to reduce the impact of natural and human-caused hazards on people and the built environment. The essential elements of a hazard mitigation plan include a risk assessment, capability assessment, and mitigation strategy.



Disaster Recovery Plan: A disaster recovery plan serves to guide the physical, social, environmental, and economic recovery and reconstruction process following a disaster. In many instances, hazard mitigation principles and practices are incorporated into local disaster recovery plans with the intent of capitalizing on opportunities to break the cycle of repetitive disaster losses. Disaster recovery plans can also lead to the preparation of disaster redevelopment policies and ordinances to be enacted following a hazard event.

- Eleven out of 20 jurisdictions have or are developing Disaster Recovery Plans, although some jurisdictions indicate that other plans include this topic, e.g., an emergency operations plan, and there is no separate disaster recovery plan that addresses long-term recovery issues.

Emergency Operations Plan: An emergency operations plan outlines responsibilities and the means by which resources are deployed during and following an emergency or disaster.

- Fifteen out of 20 jurisdictions have their own local emergency operations plans.

Continuity of Operation Plan: A continuity of operations plan establishes a chain of command, line of succession, and plans for backup or alternate emergency facilities in case of an extreme emergency or disaster event.

- Survey results indicate that seven jurisdictions do not have continuity of operations plans in place.

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

- Twelve jurisdictions have a plan to address radiological emergencies.

SARA Title III Emergency Response Plan: A Superfund Amendments and Re-authorization Act (SARA) Title III Emergency Response Plan outlines the procedures to be followed in the event of a chemical emergency such as the accidental release of toxic substances. These plans are required by federal law under Title III of the SARA, also known as the Emergency Planning and Community Right-to-Know Act.

- Fourteen jurisdictions have an Emergency Response Plan for chemical emergencies.

General Planning

The implementation of hazard mitigation activities often involves agencies and individuals beyond the emergency management profession. Stakeholders may include local planners, public works officials, economic development specialists, and others. In many instances, concurrent local planning efforts will help to achieve or complement hazard mitigation goals even though they are not designed as such. Therefore, the *Capability Assessment Survey* also asked questions regarding each jurisdiction's general planning capabilities and the degree to which hazard mitigation is integrated into other on-going planning efforts.

Comprehensive Land Use Plan: A comprehensive land use plan establishes the overall vision for what a community wants to be and serves as a guide to future governmental decision making. Typically a comprehensive plan contains sections on demographic conditions, land use, transportation elements, and community facilities. Given the broad nature of the plan and its



regulatory standing in many communities, the integration of hazard mitigation measures into the comprehensive plan can enhance the likelihood of achieving risk reduction goals, objectives, and actions.

- Survey results indicate that 16 jurisdictions have a comprehensive land use plan. All the jurisdictions indicated that their land use plans either strongly support or help facilitate hazard loss reduction. Some jurisdictions indicated that although hazard mitigation is not specifically addressed in the plan, some elements of the plan might be relevant to hazard mitigation (e.g., environmental protection).

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

- Survey results indicate that all jurisdictions have a capital improvements plan in place or under development. Most of these are five-year plans that are updated annually, and all survey respondents indicated they either support or facilitate loss reduction efforts in their community.

Historic Preservation Plan: A historic preservation plan is intended to preserve historic structures or districts within a community. An often overlooked aspect of the historic preservation plan is the assessment of buildings and sites located in areas subject to natural hazards, and the identification of ways to reduce future damages.³⁶ This may involve retrofitting or relocation techniques that account for the need to protect buildings that do not meet current building standards, or are within a historic district that cannot easily be relocated out of harm's way.

- In 2006, survey results indicate that 10 out of 14 jurisdictions have a historic preservation plan for their communities. Arlington County, the Town of Dumfries, and the Town of Vienna indicated that they do not have any plans that address historic preservation. In 2010, this information was not changed.

Zoning Ordinances: Zoning represents the primary means by which land use is controlled by local governments. As part of a community's police power, zoning is used to protect the health, safety, and welfare of those in a given jurisdiction that maintains zoning authority. A zoning ordinance is the mechanism through which zoning is typically implemented. Since zoning regulations enable municipal governments to limit the type and density of development, it can serve as a powerful tool when applied in identified hazard areas.

- Survey results indicate that all jurisdictions in the Northern Virginia region have adopted and enforce a zoning ordinance. All jurisdictions indicated that their zoning ordinance either strongly supports or helps facilitate hazard loss reduction.

Subdivision Ordinances: A subdivision ordinance is intended to regulate the development of housing, commercial, industrial, or other uses, including associated public infrastructure, as land is subdivided into buildable lots for sale or future development. Subdivision design that accounts for natural hazards can dramatically reduce the exposure of future development.²

² For additional information regarding the use of subdivision regulations in reducing flood hazard risk, see



- Survey results indicate that all jurisdictions in the Northern Virginia region, except Arlington County, have adopted and enforce a subdivision ordinance. The jurisdictions indicated that their ordinance either strongly supports or helps facilitate hazard loss reduction.

Building Codes, Permitting and Inspections: Building Codes regulate construction standards. In many communities permits are issued for, and inspections of work take place on, new construction. Decisions regarding the adoption of building codes (that account for hazard risk), the type of permitting process required both before and after a disaster, and the enforcement of inspection protocols all affect the level of hazard risk faced by a community.

- The Virginia Uniform Statewide Building Code (USBC) is a State regulation promulgated by the Virginia Board of Housing and Community Development for the purpose of establishing minimum regulations to govern the construction and maintenance of buildings and structures. As of October 1, 2003, the 2000 version of the International Building Code and International Fire Code were adopted by the Commonwealth of Virginia.
- As provided in the USBC Law, the USBC supersedes the building codes and regulations of the counties, municipalities, and other political subdivisions and state agencies.

The adoption and enforcement of building codes by local jurisdictions is routinely assessed through the Building Code Effectiveness Grading Schedule (BCEGS) program developed by the Insurance Services Office, Inc. (ISO).³ Under the BCEGS program, ISO assesses the building codes in effect in a particular community and how the community enforces its building codes, *with special emphasis on mitigation of losses from natural hazards*. The results of BCEGS assessments are routinely provided to ISO's member private insurance companies, which in turn may offer ratings credits for new buildings constructed in communities with strong BCEGS classifications. The concept is that communities with well-enforced, up-to-date codes should experience fewer disaster-related losses, and as a result should have lower insurance rates.

In conducting the assessment, ISO collects information related to personnel qualification and continuing education, as well as number of inspections performed per day. This type of information combined with local building codes is used to determine a grade for that jurisdiction. Table 5.5 shows the BCEGS rating for the jurisdictions in the Northern Virginia region. The grades range from 1 to 10, with the lower grade being better. A BCEGS grade of 1 represents exemplary commitment to building code enforcement, and a grade of 10 indicates less than minimum recognized protection.

Subdivision Design in Flood Hazard Areas. 1997. Morris, Marya. Planning Advisory Service Report Number 473. American Planning Association: Washington, D.C.

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



Table 5.5. BCEGS Rating for the Northern Virginia Region		
Jurisdiction	Year of Evaluation	BCEGS Rating
Arlington County	2000	3
Fairfax County	1997	3
Loudoun County	1997	3
Prince William County	1997	4
Alexandria, City of	1998	3
Fairfax, City of	1998	4
Falls Church, City of	1999	5
Manassas, City of	1997	4
Manassas Park, City of	2000	3
Dumfries, Town of	1997	5
Herndon, Town of	1997	3
Leesburg, Town of	1997	3
Purcellville, Town of	1997	3
Vienna, Town of	N/A	N/A

Source: Insurance Services Office, Inc. (ISO)

1. NFIP participation

Communities that regulate development in floodplains are able to participate in the NFIP. In return, the NFIP makes federally-backed flood insurance policies available for eligible properties in the community. All of the participating jurisdictions included in this planning initiative participate in the NFIP. The table below shows when each of the jurisdictions began participating in the NFIP. The table also provides the date of the FIRM in effect in each community. These maps were developed by FEMA or its predecessor and show the boundaries of the 100-year and 500-year floods. As the table shows, 13 of the maps are over 15 years old. Parts of the planning area have experienced dramatic growth over the past decade that is not reflected in the FIRM. This difference may mean that the actual floodplain varies from that depicted on the map.

Table 5.6. Communities participating in the NFIP.					
Community Name	Init FHBM Identified	Init FIRM Identified	Current Effective Map Date	Reg-Emer Date	DFIRM/Q3
Arlington County		10/1/1969	5/3/1982	12/31/1976	DFIRM
Fairfax County	5/5/1970	3/5/1990	3/5/1990	1/7/1972	DFIRM
Town of Herndon	6/14/1974	8/1/1979	8/1/1979	8/1/1979	
Town of Vienna	8/2/1974	2/3/1982	2/3/1982	2/3/1982	
Town of Clifton	3/28/1975	5/2/1977		5/2/1977	
Loudoun County	4/25/1975	1/5/1978	7/5/2001	1/5/1978	DFIRM
Town of Leesburg	8/3/1974	9/30/1982	7/5/2001	9/30/1982	
Town of Purcellville	7/11/1975	11/15/1989	7/5/2001	11/15/1989	
Town of		7/5/2001	7/5/2001	7/31/2001	



Table 5.6. Communities participating in the NFIP.

Community Name	Init FHBM Identified	Init FIRM Identified	Current Effective Map Date	Reg-Emer Date	DFIRM/Q3
Middleburg					
Town of Round Hill	5/13/1977	7/5/2001	7/5/2001	1/10/2006	
Prince William County	1/10/1976	12/1/1981	1/5/1995	12/1/1981	DFIRM
Town of Dumfries	6/18/1976	5/15/1980	1/5/1995	5/15/1980	
Town of Haymarket	8/9/1974	1/17/1990	1/5/1995	1/31/1990	
Town of Occoquan	7/19/1974	9/1/1978	1/5/1995	9/1/1978	
Town of Quantico	11/1/1974	8/15/1978	1/5/1995	8/15/1978	
City of Alexandria	8/22/1969	8/22/1969	5/15/1991	5/8/1970	Q3
City of Fairfax	5/5/1970	12/23/1971	6/2/2006	12/17/1971	DFIRM
City of Falls Church	9/6/1974	2/3/1982	7/16/2004	2/3/1982	DFIRM
City of Manassas	5/31/1974	1/3/1979	1/5/1995	1/3/1979	DFIRM
City of Manassas Park	3/11/1977	9/29/1978	1/5/1995	9/29/1978	DFIRM

as of 7/6/2010 <http://www.fema.gov/cis/VA.html>

C. Fiscal Capability

For Fiscal Year 2010, the budgets of the participating jurisdictions range from \$1.3 Million (Town of Middleburg) to \$1.2 Billion (Fairfax County). The table below shows the total budget amounts for each jurisdiction in addition to the amount budgeted for public safety, public works and their respective planning and zoning departments. The Towns of Clifton, Quantico, and Occoquan and the City of Manassas Park did not have fiscal year 2010 budgetary information available for review.

Table 5.7. 2010 budgets by jurisdiction

Jurisdiction	FY 2010 Budget (\$)	Public Works Budget (\$)	Public Safety Budget (\$)	Planning Budget (\$)
Alexandria, City of	530M	27.2M	33M	5.3M
Arlington County	946.8M	70.2M	104M	9.2M
Clifton, Town of	<i>Not Available for Review</i>			
Dumfries, Town of	4M	0.25M	1.3M	0.215M
Fairfax County	1.21B	421M	62.8M	10.6M



Table 5.7. 2010 budgets by jurisdiction				
Jurisdiction	FY 2010 Budget (\$)	Public Works Budget (\$)	Public Safety Budget (\$)	Planning Budget (\$)
Fairfax, City of	126M	10.9M	19.1M	2M
Falls Church, City of	66.9M	0.671M	9.4M	0.746M
Haymarket, Town of	1.2M	0.116M	0.352M	.0038M
Herndon, Town of	41.1M	8.8M	8.5M	1.3M
Leesburg, Town of	45.1M	10.9M	10.9M	1.58M
Loudoun County	1.1B	<i>Not Available for Review</i>	131M	0.607M
Manassas Park, City of	<i>Not Available for Review</i>			
Manassas, City of	100M	7.5M	19M	.462M
Middleburg, Town of	1.3M	<i>Not Available for Review</i>	0.48M	0.142M
Occoquan, Town of	<i>Not Available for Review</i>			
Prince William County	845M	1.9M	13M	0.93M
Purcellville, Town of	13.5M	2.8M	1.5M	0.564M
Quantico, Town of	<i>Not Available for Review</i>			
Round Hill, Town of	2.7 M	1.4 M	<i>Not Available for Review</i>	<i>Not Available for Review</i>
Vienna, Town of	20.8M	6.7M	5.6M	.746M

The counties, cities, and towns receive most of their revenue through State and local sales tax, local services, and through restricted intergovernmental contributions (Federal and State pass through dollars). It is unlikely that any of the counties, cities, or towns could easily afford to provide the local match for the existing hazard mitigation grant programs. Considering the current budget deficits at both the State and local government level in Virginia, combined with the apparent increased reliance on local accountability by the Federal government, this is a significant and growing concern.

The following table is an update to the 2006 Northern Virginia Hazard Mitigation Plan. The table highlights each jurisdiction’s fiscal capability through the identification of locally available financial resources. A (Y) indicates that the given fiscal resource is locally available for hazard mitigation purposes (including match funds for State and Federal mitigation grant funds). A (Y*) indicates that capability is new as of the 2010 update.



5.8. Fiscal capabilities by jurisdiction

Jurisdiction	Capital Improvement Programming	Community Development Block Grants	Special Purpose Taxes	Gas / Electric Utility Fees	Water / Sewer Fees	Stormwater Utility Fees	Development Impact Fees	General Obligation Bonds / Revenue Bonds / Special Tax Bonds	Partnering Arrangements or Intergovernmental Agreements
Alexandria, City of	Y	Y	Y		Y		Y	Y	Y
Arlington County	Y	Y	Y*	Y*	Y*	Y*		Y	Y
Clifton, Town of	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*
Dumfries, Town of	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fairfax County	Y	Y	Y	Y	Y	Y*	Y*	Y	Y
Fairfax, City of	Y		Y		Y				
Falls Church, City of	Y	Y			Y	Y	Y	Y	Y
Haymarket, Town of	Y*							Y*	
Herndon, Town of	Y	Y	Y	Y*	Y	Y*	Y*	Y	Y
Leesburg, Town of	Y		Y*	Y	Y			Y	Y
Loudoun County	Y	Y	Y					Y	Y*
Manassas Park, City of	Y	Y			Y	Y		Y	Y
Manassas, City of	Y	Y	Y	Y	Y	Y		Y	Y
Middleburg, Town of	Y*	Y*			Y*			Y*	Y*
Occoquan, Town of									
Prince William County	Y	Y	Y		Y	Y	Y	Y	Y
Purcellville, Town of	Y	Y			Y			Y	Y
Quantico, Town of									
Round Hill, Town of	Y*			Y*	Y*			Y*	Y*
Vienna, Town of	Y	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*



Chapter 6: Mitigation Strategies

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

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

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

For the 2010 update, the regional goals, objectives, and strategies were re-examined by the committee and jurisdictions and new goals and strategies were included in this section of the plan update. Local jurisdiction strategies are included in Chapter 7.

I. Planning Process for Setting Mitigation Goals

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

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

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

The MAC discussed regional goals and objectives for this plan at two points in the planning process. First, they attended a workshop on July 12, 2010, to discuss the results of the HIRAs and to begin developing the mitigation strategy by discussing the 2006 mitigation goals. These original goals were broad and applicable to the region and the committee felt that in general, they



still were applicable to the 2010 plan update. Then, during the final hazard identification and risk assessment presentation on October 18, 2010, the committee finalized the regional goals and developed one regional strategy per goal. This process was completed by looking at the jurisdiction-specific actions and the regional goals, and determining from there the type of objectives that would be the most logical extension.

Following the development of the regional goals, jurisdictional meetings were conducted during the months of September and early October 2010. During these separate jurisdictional meetings, the HIRA was presented to the attendees, and then strategies, or actions, were developed specific to each jurisdiction. Most of these actions are dynamic and can change and have been organized into a Mitigation Action Plan for the Region and its member jurisdictions.

Data collection supports the goals and recommended actions in two ways. First, the HIRA data identifies areas exposed to hazards, at-risk critical facilities, and future development at risk. Second, the Capability Assessment data identifies areas for integration of hazard mitigation into existing polices and plans.

The MAC members used the results of the data collection efforts to develop goals and prioritize actions for the region and their jurisdiction. The priorities differ somewhat from jurisdiction to jurisdiction. Each jurisdiction's priorities were developed based on past damages, existing exposure to risk, other community goals, and weaknesses identified by the local government capability assessments.

II. Considering Mitigation Alternatives

During the separate jurisdictional meetings that occurred between September and early October 2010, members of each jurisdiction were presented with the HIRA findings. Discussions held during the meeting resulted in the generation of a range of potential mitigation goals and actions to address the hazards. A range of alternatives were then identified and prioritized by each jurisdiction. These alternatives are presented in Chapter 7.

A. Identification and Analysis of Mitigation Techniques

In formulating Northern Virginia's mitigation strategy, a wide range of activities were considered in order to help achieve the general regional goals in addition to the specific hazard concerns of each participating jurisdiction. This includes the following activities as recommended by the Emergency Management Accreditation Program³⁷ (EMAP):

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



- 11) Redundancy or duplication of essential personnel, critical systems, equipment, and information materials.

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

Prevention

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

- Planning and zoning;
- Building codes;
- Open space preservation;
- Floodplain regulations;
- Stormwater management regulations;
- Drainage system maintenance;
- Capital improvements programming; and
- Shoreline / riverine / fault zone setbacks.

Property Protection

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

- Acquisition;
- Relocation;
- Building elevation;
- Critical facilities protection;
- Retrofitting (e.g., windproofing, floodproofing, seismic design techniques, etc.);
- Safe rooms, shutters, shatter-resistant glass; and
- Insurance.

Natural Resource Protection

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

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



- Slope stabilization,

Structural Projects

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

- Reservoirs;
- Dams / levees / dikes / floodwalls / seawalls;
- Diversions / detention / retention;
- Channel modification;
- Beach nourishment; and
- Storm sewers.

Emergency Services

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

- Warning systems;
- Evacuation planning and management;
- Emergency response training and exercises;
- Sandbagging for flood protection; and
- Installing temporary shutters for wind protection.

Public Education and Awareness

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

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

B. Prioritizing Alternatives

Through discussion and self analysis, each jurisdiction used the STAPLE/E (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) Criteria when considering and prioritizing the most appropriate mitigation alternatives for the Region’s communities. This methodology requires that social, technical, administrative, political, legal, economic, and environmental considerations be taken into account when reviewing potential actions for the area’s jurisdictions to undertake. This process was used to help ensure that the most equitable and feasible actions would be undertaken based on a jurisdiction’s capabilities.



Table 6.1, below, provides information regarding the review and selection criteria for alternatives.

Table 6.1. STAPLE/E Review and Selection Criteria for Alternatives	
Social	
<ul style="list-style-type: none"> ▪ Is the proposed action socially acceptable to the community(s)? ▪ Are there equity issues involved that would mean that one segment of a community is treated unfairly? ▪ Will the action cause social disruption? 	
Technical	
<ul style="list-style-type: none"> ▪ Will the proposed action work? ▪ Will it create more problems than it solves? ▪ Does it solve a problem or only a symptom? ▪ Is it the most useful action in light of other community(s) goals? 	
Administrative	
<ul style="list-style-type: none"> ▪ Can the community(s) implement the action? ▪ Is there someone to coordinate and lead the effort? ▪ Is there sufficient funding, staff, and technical support available? ▪ Are there ongoing administrative requirements that need to be met? 	
Political	
<ul style="list-style-type: none"> ▪ Is the action politically acceptable? ▪ Is there public support both to implement and to maintain the project? 	
Legal	
<ul style="list-style-type: none"> ▪ Is the community(s) authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity? ▪ Are there legal side effects? Could the activity be construed as a taking? ▪ Is the proposed action allowed by a comprehensive plan, or must a comprehensive plan be amended to allow the proposed action? ▪ Will the community(s) be liable for action or lack of action? ▪ Will the activity be challenged? 	
Economic	
<ul style="list-style-type: none"> ▪ What are the costs and benefits of this action? ▪ Do the benefits exceed the costs? ▪ Are initial, maintenance, and administrative costs taken into account? ▪ Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)? ▪ How will this action affect the fiscal capability of the community(s)? ▪ What burden will this action place on the tax base or local economy? ▪ What are the budget and revenue effects of this activity? ▪ Does the action contribute to other community goals, such as capital improvements or economic development? ▪ What benefits will the action provide? 	
Environmental	
<ul style="list-style-type: none"> ▪ How will the action affect the environment? • Will the action need environmental regulatory approvals? • Will it meet local and state regulatory requirements? 	

**Table 6.1. STAPLE/E Review and Selection Criteria for Alternatives**

- Are endangered or threatened species likely to be affected?

Ranking was completed in order of relative priority based on the STAPLE/E criteria, as well as the strategy's potential to reduce vulnerability to natural hazards.

III. Identifying Objectives and Strategies

A. Goals and Strategies

Through a series of jurisdictional meetings, the following goals and strategies for the region were accepted by the MAC. The goals and strategies form the basis for the development of a Mitigation Action Plan and specific mitigation projects to be considered for the Region. The process consisted of 1) setting goals, 2) considering mitigation alternatives, 3) identifying strategies, and 4) developing an action plan resulting in a mitigation strategy.

Community officials should consider the goals that follow before making community policies, public investment programs, economic development programs, or community development decisions for their communities. In addition, Regional strategies have been developed for each goal. These strategies state a more specific outcome that the jurisdictions of the Northern Virginia region expect to accomplish over the next five years. The strategies will outline the specific steps necessary to achieve that end.

Regional Goals and Strategies

- Goal 1: Improve the quality and utilization of best available data for conducting detailed hazard risk assessments and preparing meaningful mitigation action plans.
- Goal 2: Increase the capability of the Northern Virginia jurisdictions to successfully mitigate hazards to include participation in grant programs, revision of codes, expansion of programs such as the Community Rating System, and continuation or expansion of outreach programs.
- Goal 3: Develop and maintain specific plans to minimize the effects of known hazards in the region.
- Goal 4: Improve existing local policies, codes, and regulations to reduce or eliminate the impacts of known hazards. This includes maintaining continued compliance with the NFIP for all participating jurisdictions.
- Goal 5: Investigate and implement a range of structural projects that will reduce the effects of natural and human-caused hazards on public and private property throughout the region.
- Goal 6: Increase the public's awareness of natural and human-caused hazard risks in the Northern Virginia region, while also educating residents and businesses on the mitigation measures available to minimize those risks.

The previous regional strategy from the 2006 plan stated: Coordinate with participating local jurisdictions on the acquisition and/or development of improved GIS data layers for use in conducting enhanced risk assessment studies for future updates to the Northern Virginia Regional Hazard Mitigation Plan, in a continuing effort within the region. The region has



successfully increased is GIS capacity over the last five years and each community has coordinated with each other to ensure dataset synergies where appropriate.



Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority
Develop an improved critical facility dataset to use in emergency planning efforts and the 2016 mitigation plan update.	Northern Virginia Emergency Managers Committee	X	X	X	X	X	X	X	X	X	X	X	X	X	X	EMPG Funds HMGP 7% PDM Planning Other DHS funds.	June 2016	Define critical facility and identify which DHS category will be included in dataset by June 2012	Critical
Coordinate with VDEM on obtaining funding opportunities to implement jurisdiction strategies.	Northern Virginia Emergency Managers Committee	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N/A	June 2016	Identify at least two funding sources by June 2011	High
Conduct a regional commodity flow study and develop recommendations from these studies to implement effective mitigation actions.	Fairfax County Office of Emergency Management														X	EMPG DHS SARA Title II (EPA)	January 2014	Secure funding by June 2011	High
Educate elected officials and residents on the importance of the NFIP.	Jurisdictional Offices of Emergency Management	X		X		X										HMGP 5% Initiative Projects	June 2016	Develop informational memorandums to disseminate by June 2012	High
Acquire, elevate, retrofit properties located in the floodplain per local jurisdiction plans.	Jurisdictional Offices of Emergency Management	X		X		X										FEMA HMA Programs	June 2016	Acquire, elevate, and/or retrofit at least 3 properties per year in the region.	High
Update, print and distribute "NOVA EM Prep Guide" and include mitigation.	Loudoun County Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	EMPG HMGP 5% Initiative Projects	January 2012	Update the guide by June 2011	High



Local Mitigation Strategies

In formulating a mitigation strategy, a wide range of activities was considered in order to help achieve the goals and to lessen the vulnerability of the Northern Virginia area to the effects of natural hazards. Through a series of jurisdictional meetings, conference calls, and e-mail exchanges from August through December 2010, all of the jurisdictions (county, cities, and towns) participated in the development and review of the local mitigation strategy.

Strategies were ranked by each community. Ranking was completed in order of relative priority based on the STAPLE/E criteria, as well as the strategy's potential to reduce vulnerability to natural hazards. Actions were given a ranking of high, medium, or low, with the following meanings:

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

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 and outreach, the relationship of the probable future benefits and the cost of each measure was considered when developing the mitigation actions. Each jurisdiction's mitigation strategy can be found in Chapter 7 and the status of the 2006 mitigation strategies can be found in Appendix E. Where a strategy's status is blank, updates were unable to be retrieved from the jurisdiction's representative.

Each of the strategies are numbered in the action plans below and listed in order of their prioritization (High, Medium, or Low). When a strategy number includes "(2010)", infers that particular strategy was developed for the 2010 plan update. A number with a "(2006)" after it,



denotes that that particular action was carried forward from the 2006 plan (utilizing the 2006 numbering system) and revised for the 2010 update.



Chapter 7: Jurisdiction Executive Summaries

Chapter 7 is a new chapter for the 2010 plan update. It was reviewed and approved by the Northern Virginia MAC.

I. Alexandria

What is now the City of Alexandria was first settled as part of the British Colony of Virginia in the late 1690s. In 1791, George Washington included portions of the City of Alexandria in what was to become the District of Columbia. That portion was given back to Virginia in 1846 and the City of Alexandria was re-chartered in 1852. In 1870, the City of Alexandria became independent of Alexandria County, with the remainder of the county changing its name to Arlington County in 1920. The population of the city was 128,283 as of the 2000 Census and was estimated to be 141,738 in 2009.



Alexandria has a moderate climate. The average annual temperature is approximately 58 degrees. Temperatures generally range from January lows in the mid-20s to July highs in the upper-80s and lower-90s. Annual precipitation averages above 40 inches and approximately 14 - 16 inches of snow falls in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Alexandria's high population density and its location along the banks of the Potomac River increase the city's vulnerability to a variety of hazards, most notably flooding. In addition to snow melt and rain-related river flooding episodes, Alexandria is also subjected to tidal and storm surge flooding. As sea levels rise, permanent inundation of low lying areas along and near the river shoreline is also a concern. Winter weather and high wind events also pose a significant threat to the city as the 2009 – 2010 winter and summer seasons have proven.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Alexandria, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA's NCDC³⁸. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.



The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, Winter Weather, and Landslide hazards were ranked as ‘High’ for Alexandria. See Table 7.1 for a summary of hazard rankings.

Table 7.1: Hazard Ranking for Alexandria									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	Med-High	Med	High	Med-Low	Med-Low

Annualized loss statistics for Alexandria based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.2. It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses.

Table 7.2: NCDC Annualized Loss by Hazard for Alexandria					
Annualized Loss as determine through NCDC data <i>(based on property and crop damages and years of record)</i>					
County	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss
<i>Years of Record</i>	17	21	59	17	(for all hazards)
City of Alexandria	\$57,033	\$193,936	\$149	\$60,484	\$311,602

HAZUS^{MH} provides another method for estimating annualized loss that uses science and engineering principals in addition to historical data to analyze potential damage and economic loss. Annualized loss statistic for Alexandria based on HAZUS^{MH} runs for flood, hurricane and earthquake are found in Tables 7.3, 7.4 and 7.5 below.

Table 7.3: HAZUS ^{MH} - Annualized Loss Due to Flood for Alexandria								
Jurisdiction	Building Loss	Content Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
City of Alexandria	\$6,460,000	\$5,306,000	\$54,000	\$10,000	\$1,000	\$12,000	\$7,000	\$11,850,000



Table 7.4: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Alexandria								
Jurisdiction	Building Loss	Content Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
City of Alexandria	\$387,234	\$57,628	\$427	\$30,477	\$4,701	\$17,598	\$6,277	\$504,342

Table 7.5: HAZUS ^{MH} - Annualized Loss Due to Earthquake for Alexandria	
Jurisdiction	Annualized Loss
City of Alexandria	\$198,495

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory, and related effects is extremely high at more than \$11.8 million for flooding and \$504,342 for hurricane. The earthquake annualized loss estimate is relatively low, but earthquakes occur only occasionally in the region. That was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland, shook the area.

A. Alexandria Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2006)	Adopt revised FIRM.	Transportation and Environmental Services	X		X		X										Internal funding	May 2011	Complete final adoption public review as prescribed by NFIP.	Critical	No
1 (2010)	Excavate sediment from channel bed of Cameron Run-Hunting Creek to Potomac River.	Regional project with Fairfax County and VDOT and Transportation and Environmental Services	X										X				FEMA Unified Hazard Mitigation Assistance funding, United States Army Corp of Engineers, Virginia Department of Transportation, Fairfax County, City of Alexandria	Ongoing	Secure funding for project by March 2011	High	No
5 (2006)	Purchase waterfront property to increase parkland and open space.	Department of General Services	X		X		X						X				Alexandria tax revenue dedicated to open space purchase	Ongoing	Purchase 1 property per year.	High	No
2 (2010)	Promote installation of backflow prevention valves by partially reimbursing cost of necessary plumbing fixture.	Transportation and Environmental Services	X		X		X										Internal funding	Ongoing	Create prioritized list of locations requiring back value installation.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completi on Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
3 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.	Transportation and Environmental Services	X		X		X										FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
6 (2006)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Transportation and Environmental Services	X		X		X										FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No
4 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Code Administration	X		X		X										FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
5 (2010)	Review locality's compliance with the National Flood Insurance Program with an annual	Transportation and Environmental Services	X		X		X										Local program	Ongoing	Establish a schedule of review and review	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
	review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.																		committee (if necessary) by June 2011.		
6 (2010)	Install warning signs in park areas subject to flooding.	Recreation, Parks & Cultural Activities	X		X		X										Internal funding	2011	Develop prioritized list of sites requiring signage.	Medium	No
7 (2010)	Purchase and install fire hydrant markers, whip type, to locate hydrants in snow and in the dark to mitigate urban fire hazard.	Transportation and Environmental Services		X												X	Alexandria Implement a citizen "Adopt-a-Hydrant" program	Ongoing	Develop priority list; create adoption program, perhaps using Citizen Corps or other volunteers.	Medium	No
7 (2010)	Require new buildings to be certified LEED Silver or above.	Department of General Services for local government building, Planning & Zoning for private building	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N/A	Ongoing	Create LEED requirement for Alexandria facilities through executive order or City Council policy.	Low	No
8 (2010)	Re-grade section of lower King Street, Union Street and The Strand to improve drainage and minimize flooding.	Transportation and Environmental Services	X		X		X										Alexandria Critical Infrastructure Program	2015	Integrate into capital improvement budgets; complete design and permitting.	Low	No
9 (2010)	Construct an elevated walkway along Potomac	Transportation and Environmental	X		X		X										Alexandria Critical	2020	Integrate into capital	Low	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completi on Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
	riverfront to elevation 6.0 to mitigate flooding.	Services															Infrastructure Program and developer contributions		improvement budgets; complete design and permitting.		



II. Arlington County

The area that today encompasses Arlington County was first settled as part of the British Colony of Virginia in the late 1690s. In 1791, George Washington surveyed the area in what was to become the District of Columbia. Congress returned the area to the Commonwealth of Virginia in 1842 as the County of Alexandria. In 1870, the City of Alexandria became independent of Alexandria County. The county portion was officially renamed Arlington County in 1920. The 2009 census estimate for the county is 212,038, an approximately 12% increase during the past decade. Based on the 2005-2009 American Community Survey, the county population was comprised of 71.3% white, 8.1% black or African American, 0.3% Native American, 0.1% Pacific Islander, 8.4% Asian, 8.5% from other races, and 3.3% bi-racial. Hispanic or Latino of any race were 16.7% of the total population. Arlington's schools are incredibly diverse with students from 124 nations fluent in 93 languages.



Arlington has a moderate climate. The average annual temperature is approximately 58 degrees. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 40 inches of rain and 15 inches of snowfall in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Arlington is an urban county of about 26 square miles located directly across the Potomac River from Washington DC. Arlington's central location in the Washington DC metropolitan area, its ease of access by car and public transportation, and its highly skilled labor force have attracted an increasingly varied residential and commercial mix. Arlington is one of the most densely populated communities in the nation with more than 7,315 persons per square mile.

Arlington's high population density and its location along the banks of the Potomac River, increase the county's vulnerability to a variety of hazards, most notably flooding. In addition to snow melt and rain-related river flooding episodes, Arlington is also subjected to tidal and storm surge flooding. As sea levels rise, permanent inundation of low lying areas along and near the river shoreline is also a threat. Additionally, winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Arlington, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA's NCDC³⁹. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence
- Vulnerability of population in the hazard area
- Historical impact, in terms of human lives and property and crop damage



The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, and Winter Weather hazards were ranked as ‘High’ for Arlington. See Table 7.6 for a summary of hazard rankings.

Table 7.6: Hazard Ranking for Arlington									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	Med-High	Med	Med	Med-Low	Med-Low

Annualized loss statistics for Arlington based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.7.

Table 7.7: NCDC Annualized Loss by Hazard for Arlington					
Annualized Loss as determined through NCDC data (based on property and crop damages and number of years of record)					
	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss (for all hazards)
<i>Years of Record</i>	17	21	59	17	
Arlington	\$279,199	\$230,954	\$22,033	\$60,484	\$678,428

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses. Much of the NCDC data is gathered from damage reports and insurance records. One reason Arlington’s annualized estimates using the NCDC data base are so low is the likely under-reporting by Arlington’s diverse citizenry. Many do not report damage to insurers, and many properties are not insured. Finally, Arlington has significant Federal property – damages to Federal installations such as the Pentagon or Reagan National Airport would not show in the NCDC data sets.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Arlington based on HAZUS^{MH} runs for flood, hurricane and earthquake are found in Tables 7.8, 7.9 and 7.10 below.

Table 7.8: HAZUS ^{MH} - Annualized Loss Due to Flood for Arlington								
Jurisdiction	Building	Content	Inventory	Relocation	Income	Rental	Wage	Total
Arlington	\$1,935,000	\$1,620,000	\$20,000	\$3,000	\$0	\$0	\$15,000	\$3,593,000



Table 7.9: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Arlington								
Jurisdiction	Building	Content	Inventory	Relocation	Income	Rental	Wage	Total
Arlington	\$543,847	\$77,574	\$573	\$40,176	\$5,554	\$24,946	\$7,342	\$700,012

Table 7.10: HAZUS ^{MH} - Annualized Loss Due to Earthquake for Arlington	
Jurisdiction	Annualized Loss
Arlington	\$256,214

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects is extremely high at more than \$3.5 million for flooding and more than \$700,000 for hurricane. The earthquake annualized loss estimate is relatively low, but earthquakes occasionally occur in the region. That was the case July 16, 2010 when a 3.6 magnitude quake centered near Gaithersburg, Maryland shook the area.

A. Arlington Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (Critical, High, Medium, Low)	Keep Action Red-acted (Yes/No)
1 (2010)	Enhance the ability of patrol officers, through increased training and additional equipment, to respond to active shooter and/or terrorist attacks	Police Department														X	Bureau of Justice Administration DHS funding	Dec. 2012	Funding Secured Training in progress Equipment upgrades ongoing	Critical	No
2 (2010)	Improve the ability of the SWAT Team to operate in tactical and terrorism related incidents through the purchase of CBRN equipped armored vehicle.	Police Department														X	State of Virginia Homeland Security Funds	July 2011	Funding Secured	High	No
3 (2010)	Complete a Commodity Flow Survey for the County and region.	Office of Emergency Management	X	X	X	X					X					X	UASI funding	January 2012	Secure funding and develop a planning/oversight committee June 2011.	High	No
4 (2010)	Include pandemic as a hazard in the next 5-year mitigation planning cycle	Office Emergency Management and Health Department														X	FEMA Unified Hazard Mitigation Assistance Grants	2016	Secure funding for next 5-year planning cycle by June 2014.	High	No
5 (2010)	Establish a partnership and committee between members of the County and utility companies (i.e. water, natural gas, propane, power).	Office of Emergency Management, Office of Environmental Services, Department of Transportation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	County funding and UASI grants	January 2012	Identify organizations that should be members of this committee by June 2011.	High	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (Critical, High, Medium, Low)	Keep Action Red-acted (Yes/No)
5 (2010)	Seek funding and storage space for additional cots in the NRC.	Arlington Red Cross	X	X	X	X	X		X	X	X	X	X	X	X	X	UASI	June 2011	Secure funding and storage and order supplies by January 2011.	High	No
6 (2010)	Secure additional special needs supplies to support the special needs population.	Arlington Red Cross	X	X	X	X	X		X	X	X	X	X	X	X	X	UASI	June 2011	Secure funding and storage and order supplies by January 2011.	High	No
7 (2010)	Establish and execute protocols for real time reporting on snow clearing efforts.	Department of Environmental Services, ESF 3 – Public Works and Engineering		X													County funding	June 2011	Develop protocols and test technology by January 2011.	High	No
8 (2010)	Develop alternate site for the Public Safety Communications Center.	Office of Public Safety	X	X	X	X	X	X	X	X	X	X	X	X	X	X	DHS Grants	In progress	Secure funding by April 2011.	High	No
9 (2010)	Complete battery backup of critical traffic signals.	Department of Environmental Services, Department of Transportation	X	X	X	X	X			X		X	X		X	X	County Funding	Dec. 2020	Identify funding source by December 2012 Complete 5 per year with operational funds	High	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (Critical, High, Medium, Low)	Keep Action Red-acted (Yes/No)
			X	X	X	X	X	X	X	X	X	X	X	X	X	X					
1 (2006)	Upgrade county EOC to modern standards.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Not Determined	Dec. 2015	Funding sources identified/secured by December 2012. EOC upgrade plan developed by December 2011.	High	No
2 (2006)	Evaluate, update, exercise government Continuity of Operations (COOP) plans.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	DHS grants	June 2012	Training and exercises designed by June 2011. Training and exercises implemented by May 2012. After action report June 2012. Update/Edit COOPs June 2012.	High	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (Critical, High, Medium, Low)	Keep Action Red-acted (Yes/No)
10 (2010)	Coordinate regionally to integrate multiple evacuation plans.	VDEM/Arlington County Office of Emergency Management	X	X	X	X	X		X	X		X	X	X	X	X	State and Federal funding sources	Dec. 2011	Regional evacuation plan developed by August 2011.	High	No
10 (2006)	Enhance the security of the water infrastructure system within Arlington County.	Arlington County Office of Emergency Management Department of Environmental Services	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Federal, state and local funding sources	December 2015	Conduct gap analysis of current water infrastructure security by January 2012.	High	No
11 (2010)	Secure prisoner transportation resources in the event of a jail evacuation.	Sheriff's Office	X	X	X	X	X		X	X		X	X	X	X	X	County Funding	Sept. 2011	Determine number and type of assets required by March 2011.	High	Yes
12 (2010)	Identify building(s) to house the Courts, if the Courthouse is compromised. How would wildfire impact the court building? Do you want to re-state this to "locate an appropriate redundant location for the courts facility?"	Sheriff's Office/ Department of Environmental Services				X	X		X						X	X	County Funding	June 2011	Determine capacity and resource requirements to house the Courts by February 2011.	High	No
13 (2010)	Upgrade the Courthouse security system.	Department of Environmental Services													X	X	County Funding	January 2012	Secure funding by April 2011.	High	No
14 (2010)	Secure resources and agreements for short-term housing (72 hours) for evacuated inmates.	Sheriff's Office	X	X	X	X	X		X	X		X	X	X	X	X	County Funding	Sept. 2011	Determine number and type of assets required by	High	Yes



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (Critical, High, Medium, Low)	Keep Action Red-acted (Yes/No)
																			March 2011.		
15 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, (flood insurance information) that can assist them in reducing their flood risk.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
16 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No
17 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
18	Review locality's compliance with the	Office of	X		X		X										County	Ongoing	Establish a	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completi on Date	Interim Measure of Success	Priority (Critical, High, Medium, Low)	Keep Action Red- acted (Yes/No)
(2010)	National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Emergency Management															funding.		schedule of review and review committee (if necessary) by June 2011.		
19 (2010)	Develop a Communications Plan with the private industry within Arlington County for emergency management (preparedness and response) purposes.	Office of Communications	X	X	X	X	X	X	X	X	X	X	X	X	X	X	County funding	January 2013	Create a partnering committee with at least 5 members of the private industry to assist in developing the plan by January 2012.	Medium	No
20 (2010)	Conduct a gap analysis of workforce safety within the County.	Department of Human Resources	X	X	X	X	X	X	X	X	X	X	X	X	X	X	County funding	June 2011	Establish parameters of analysis (i.e. determine what areas need to be analyzed specifically) by April 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completi on Date	Interim Measure of Success	Priority (Critical, High, Medium, Low)	Keep Action Red- acted (Yes/No)
			X	X	X	X	X	X	X	X	X	X	X	X	X	X					
21 (2010)	Establish a partnership with members of the academic community. Look at specific opportunities to partner with Virginia Tech.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	County funding	March 2011	Schedule a meeting between County and academic partners to discuss opportunities by January 2011.	Medium	No
22 (2010)	Conduct preparedness presentations in the community to ensure public awareness of steps the public can take to care for themselves during an emergency.	Arlington Red Cross	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Arlington Red Cross	June 2011	Schedule the first presentation by April 2011.	Medium	No
8 (2006)	Obtain a backup supply of generator fuel.	Department of Environmental Services, ESF 12-Energy	X	X	X	X	X	X	X	X	X		X	X		X	County funding or possible OEM grant.	August 2011	Secure funding May 2011.	Medium	No
7 (2006)	Continue training for employees and partners on the Incident Command System.	Office of Public Safety	X	X	X	X	X	X	X	X	X	X	X	X	X	X	DHS and Authority	Continual	Continue periodic training and exercise activities internally and with Arlington County.	Medium	No
23 (2010)	Acquire updated Mobile Command Vehicle.	Office of Public Safety	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Authority funding	2013	Acquire funding commitment by January 2012.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (Critical, High, Medium, Low)	Keep Action Red-acted (Yes/No)
24 (2010)	Develop Computer Aided-Design (CAD) to CAD interface between Authority and County Communication Centers.	Office of Public Safety	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Federal funding	2011	Connect the two Centers via NCRNET by June 2011.	Medium	No
25 (2010)	Expand network of traffic cameras.	Department of Environmental Services, Department of Transportation	X	X	X	X	X		X	X		X	X	X	X	FHWA County Funding	Dec. 2014	Complete Phase 1 Fiber Optics in Spring 2012	Medium	No	
4 (2010)	Expand public warning siren system within Arlington County.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	DHS grants	Dec. 2015	Funding sources identified/secured by Dec. 2012. Warning system equipment purchased/installed by Dec. 2013.	Medium	No	
6 (2006)	Certify additional shelter capacity.	Office of Emergency Management Parks, Recreation, and Cultural Resources Arlington Public Schools Other departments as identified	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance Grants	Dec. 2011	Gap analysis of sheltering capacity/locations within Arlington County by June 2011.	Medium	No	



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority (Critical, High, Medium, Low)	Keep Action Red-acted (Yes/No)
9 (2010)	Upgrade GIS system for critical infrastructure mapping.	Office of Emergency Management GIS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance Grants	Dec. 2011	Conduct gap analysis of current software capabilities by May 2011.	Medium	No
26 (2010)	Acquire the ability to have remote access to medical records.	Sheriff's Office	X	X	X	X	X	X	X	X	X	X	X	X	X	X	County Funding	January 2014	Secure funding by January 2012	Medium	No
27 (2010)	Identify the most effective tools for communications with the public during emergencies, including leveraging emerging technologies, e.g., social media.	Office of Communications	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance Grants	July 2011	Improve situational awareness to enhance public outreach and notification by April 2011.	Medium	No
28 (2010)	Identify effective means of communicating with special populations, e.g., - Non-English speakers - Special needs - Tourists - Non-digital	Office of Communications	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance Grants	Fall 2011	Hold discussions with disability coordinator, diversity coordinator, Visitors Center, Dept. of Human Services by Spring 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completi on Date	Interim Measure of Success	Priority (Critical, High, Medium, Low)	Keep Action Red- acted (Yes/No)
			X	X	X	X	X	X	X	X	X	X	X	X	X	X					
29 (2010)	Ensure delivery of critical emergency text messages (Arlington Alert) to Arlington Public Schools' School Talk alert system.	Office of Communications	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance Grants	Summer 2011	Hold discussions with Arlington Public Schools and set-up process by Spring 2011.	Medium	No
30 (2010)	Improve evidence and/or equipment inventory through the use of a bar code system.	Police Department	X	X	X	X	X	X	X	X	X	X	X	X	X	X	BZZP Grant	July 2012	Awaiting funding approval	Medium	No
31 (2010)	Equip selected vehicles with License Plate Readers (LPR) to identify stolen, felony, and Terrorist Watch List vehicles. Install a server to provide access to the data. Connect to other NCR L.E. agencies to share LPR data.	Police Department														X	UASI Funding	July 2012	Funding Secured LPR's & server installed Data sharing pending	Medium	No
8 (2006)	Acquire 6 additional generators for signal backup.	Department of Environmental Services, Department of Transportation	X	X	X	X	X			X		X	X			X	County Funding	Dec. 2011	Secure funding by June 2011.	Low	No



III. Fairfax County

The land that is now Fairfax County was part of the Northern Neck Proprietary granted by King Charles II in 1660 and inherited by Thomas Fairfax, Sixth Lord Fairfax of Cameron, in 1719. The county itself was formed in 1742 from Prince William County. The 2009 census population estimate for the county is 1,036,473, an approximately 7% increase during the past decade. Based on the 2005-2009 American Community Survey, the county population was comprised of 66.7% white, 9.2% black or African American, 0.4% Native American, 0.1% Pacific Islander, 16% Asian, 4.8% from other races, and 2.8% bi-racial. Hispanic or Latino of any race were 14% of the total population.



Fairfax County has a moderate climate. Due to its situation on both the Virginia piedmont and the Atlantic coastal plain, the county experiences a variety of weather. The average annual temperature is approximately 58 degrees. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 40 inches of rain and 15 or more inches of snow fall in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Fairfax County comprises about 407 square miles located directly across the Potomac River from Washington, DC. The county's location in the Washington metropolitan area, its ease of access by car and public transportation, and its highly skilled labor force have attracted an increasingly varied residential and commercial mix. Most commercial development is centered in Tysons Corner, which is the 12th largest central business district in the Nation.

The diversity of Fairfax County's landscape increases the county's vulnerability to a variety of hazards, most notably flooding and severe storms. In addition to snow melt and rain-related river flooding episodes, low-lying areas of Fairfax County along the Potomac River are also subject to tidal and storm surge flooding. As sea levels rise, permanent inundation of low lying areas along and near the river shoreline is also a threat. Additionally, winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Fairfax County, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA's NCDC⁴⁰. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.



The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, and Winter Weather hazards were ranked as ‘High’ for Fairfax County. See Table 7.11 for a summary of hazard rankings.

Table 7.11: Hazard Ranking for Fairfax County									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	Med-High	Med	Med-Low	Med	Med-Low

Annualized loss statistics for Fairfax County based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.12.

Table 7.12: NCDC Annualized Loss by Hazard for Fairfax County					
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)					
	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss (for all hazards)
<i>Years of Record</i>	17	21	59	17	
Fairfax County	\$801,903	\$612,562	\$2,265,041	\$60,537	\$3,830,698

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses. Much of the NCDC data is gathered from damage reports and insurance records. Fairfax County has significant Federal property – damages to Federal installations such as Fort Belvoir would not show in the NCDC data sets.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Fairfax County based on HAZUS^{MH} runs for flood, hurricane and earthquake are found in Tables 7.13, 7.14 and 7.15 below.

Table 7.13: HAZUS ^{MH} - Annualized Loss Due to Flood for Fairfax County								
Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
Fairfax	\$27,603,000	\$19,456,000	\$85,000	\$46,000	\$0	\$5,000	\$19,000	\$47,214,000



Table 7.14: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Fairfax County								
Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
Fairfax County	\$2,086,176	\$212,519	\$1,641	\$119,367	\$11,790	\$50,745	\$13,512	\$2,495,750

Table 7.15: HAZUS ^{MH} - Annualized Loss Due to Earthquake for Fairfax County	
Jurisdiction	Annualized Loss
Fairfax County	\$1,194,034

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects is extremely high at more than \$47.2 million for flooding and nearly \$2.5 million for hurricane. Earthquakes occasionally occur in the region; that was the case July 16, 2010 when a 3.6 magnitude quake centered near Gaithersburg, Maryland shook the area.

A. Fairfax County Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Survey generator hookups throughout the County.	Department of Public Works	X	X	X	X	X	X	X	X	X	X	X	X	X	X	County funding	January 2012	Complete shelter survey by June 2011	Critical	No
22 (2006)	Install piezometers at six PL566 Pohick Creek Dams and the Holmes Run Reservoir (Res 2A) and connect these to an electronic real-time monitoring system so that the phreatic surface in the dams of these facilities can be closely monitored, particularly after major storm events.	Stormwater Planning	X		X	X						X					Hazard Mitigation Assistance grant funding, US Army Corp of Engineers, County Funding	January 2014	Install at least 3 piezometers by January 2013.	High	Yes
2 (2010)	Encourage homeowners to make homes more resilient to wind and flood by additional outreach methods such as websites and brochures.	Office of Emergency Management, Office of Public Affairs	X		X	X	X										County funding	December 2011	Include mitigation strategies on the County website by April 2011.	High	No
3 (2010)	Engage in a public private partnership to encourage people to report suspicious activity "See something, say something."	Office of Emergency Management, Police Department														X	County funding	December 2011	Develop a schedule for placing dynamic message boards around the County in April 2011.	High	No
4 (2010)	Educate the public about the dangers of driving through flooded roadways, maintain depth signs and police presence at high hazard water crossings.	Office of Emergency Management	X		X	X											County funding	May 2011	Develop radio and/or newspaper and television advertisements for public release by April 2011.	High	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
5 (2010)	Work with private dam owners to repair or decommission private dams within the county.	Department of Public Works										X					Hazard Mitigation Grant Program – 5% initiative funds FEMA has a national dam safety program: unsure if funding is available. Virginia Floodplain Management Fund (administered by DCR Division of Dam Safety and Floodplain Management)	December 2015	Identify all private dam owners by January 2012.	High	No
6 (2010)	Continue to employ a broad range of warning systems throughout the county.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UASI funding, DHS grants, county funding	December 2015	Identify one new warning system to utilize by December 2012.	High	No
7 (2010)	Develop a policy of “record keeping and maintenance” to support the County’s financial recovery efforts following an event.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	County funding	July 2011	Draft the initial policy by March 2011.	High	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
8 (2010)	Develop training and education courses for first responders to deal with transportation-based hazardous materials releases.	Police Department, Fire Department														X	UASI funding, DHS grants	July 2013	Identify specific topics that should be included in the training, and their target audience, by July 2011.	High	No
9 (2010)	Secure funding and conduct a commodity flow study (region-wide preferably).	Office of Emergency Management, Fire Department														X	UASI funding	December 2012	Secure funding by June 2011.	High	No
10 (2010)	County facilities need to be inventoried, evaluated and mitigated (by priority).	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance Grants	July 2012	Create inventory database by July 2011.	High	No
11 (2010)	County shelters do not meet CAT 4 requirements. Secure funding and conduct a study to examine buildings (schools, recreation centers, etc).	Fairfax County Health Department, Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	HMGP funding	December 2012	Secure funding by October 2011.	High	No
12 (2010)	Identify funding opportunities to replace vulnerable or undersized culvert stream crossings with bridges or larger culverts to reduce flood hazards.	Park Authority	X		X						X						FEMA Unified Hazard Mitigation Assistance Grants	December 2015	Develop list of vulnerable or undersized culverts by January 2012.	High	Yes



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
13 (2010)	Increase flood warning capabilities, particularly as they relate to dam failure.	Park Authority	X		X		X					X					FEMA Unified Hazard Mitigation Assistance Grants	January 2014	Identify warning system best suitable for dam failure by January 2012.	High	Yes
14 (2010)	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.	Park Authority	X		X		X					X					FEMA Unified Hazard Mitigation Assistance Grants	December 2013	Secure funding by December 2011.	High	Yes
15 (2010)	Retrofit Huntsman Lake, a high-hazard state-regulated dam, to adequately pass the Spillway Design Flood.	Stormwater Planning	X		X		X									X	Hazard Mitigation Assistance grant funding, US Army Corp of Engineers, County Funding	December 2016	Completed engineering assessment of retrofit needs by December 2012.	High	No
16 (2010)	Upgrade the New Alexandria/Belle View pump station and tide gate.	Stormwater Planning	X		X		X										Hazard Mitigation Assistance grant funding, US Army Corp of Engineers, County Funding	June 2014	Secure funding by June 2012.	High	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
5 (2006)	Continue to install remote lake level sensors, data collectors/alarms, stream flow gauges, tide gauges and rain gauges at critical locations throughout the county to allow for earlier warning of potential flooding. Continue to develop action plans for public education and warning.	Stormwater Planning	X		X		X					X					Hazard Mitigation Assistance grant funding, US Army Corp of Engineers, County Funding	Ongoing	Establish prioritization for installation by December 2011.	High	No
17 (2010)	Continue to seek voluntary buy-outs of FEMAs repetitive loss properties within the floodplain.	Stormwater Planning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Hazard Mitigation Assistance grant funding, County Funding	Ongoing	Complete one buy-out per year.	High	No
2 (2006)	Continue to implement flood proofing methods for some structures based on the outcome of analyzing alternative solutions to flood causes.	Stormwater Planning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Hazard Mitigation Assistance grant funding, County Funding	Ongoing	Implement flood proofing methods for at least one county facility each year.	High	No
18 (2010)	Develop and implement a stormwater management ordinance.	DPWES, Planning and Zoning	X		X		X									X		January 2012	Complete a draft ordinance by July 2011.	High	No
19 (2010)	Improve the county's Community Rating System (CRS) classification from Class 7 to Class 6.	Stormwater Planning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Hazard Mitigation Assistance grant funding, County Funding	January 2012	Examine criteria and establish roles and responsibilities for completion by January 2011.	High	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
20 (2010)	Collaborate with FEMA to develop risk maps for the Cameron Run Watershed and the Belle View communities.	Stormwater Planning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Hazard Mitigation Assistance grant funding, County Funding	December 2015	Form a working group by December 2013.	High	No
21 (2010)	Develop an outreach program aimed at assisting private dam owners.	Stormwater Planning	X		X	X						X					Hazard Mitigation Grant Program – 5% initiative funds FEMA has a national dam safety program: unsure if funding is available. Virginia Floodplain Management Fund (administered by DCR Division of Dam Safety and Floodplain Management)	June 2013	Identify specific outreach techniques for this audience by June 2011.	High	Yes
22 (2010)	Develop a public outreach plan specific to evacuation-communication before and during an event.	Office of Emergency Management, Police Department	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UASI funding	January 2012	Create a planning committee by January 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
23 (2010)	Identify gaps in current Recovery Planning efforts within the county.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	County funding	July 2011	Establish metrics for review of plan by February 2011.	Medium	No
24 (2010)	Continue to plan and exercise anthrax related events.	Office of Emergency Management, Police Department, Fire Department														X	UASI funding	December 2011	Schedule and develop a planning committee for an exercise by March 2011.	Medium	No
13 (2006)	Identify need for backup generators, communications, and/or vehicles at critical public facilities. Develop means to address shortfall identified.	Park Authority	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UASI funding, county funding	July 2014	Conduct generator survey to identify which facilities require a backup generator by January 2012.	Medium	Yes
25 (2010)	Encourage purchase of NOAA radios. Provide NOAA weather radios to public facilities.	Park Authority	X	X	X	X	X		X	X		X				X	UASI funding, DHS grants, county funding	December 2011	Secure funding by June 2011.	Medium	Yes
26 (2010)	Use fee simple and/or permanent easement to prevent development in the highest priority undeveloped floodplain (and/or wetlands) areas. Work with land trusts to purchase the land or conservation easements. Use these areas as public open space for passive recreational uses.	Park Authority	X														FEMA Unified Hazard Mitigation Assistance Grants, county funding	December 2013		Medium	Yes



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
26 (2006)	Continue to update GIS to 2-foot contours from 5-foot contours (part of the overall planimetrics features update).	DIT/ Stormwater Planning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Hazard Mitigation Assistance grant funding, County Funding	Ongoing	Complete half of the county by December 2014.	Medium	No
28 (2006)	Continue to implement building and development standards as required under the National Flood Insurance Program.	DPWES	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Hazard Mitigation Assistance grant funding, US Army Corp of Engineers, County Funding	Ongoing	Implement one new standard (at least at County facilities) every year.	Medium	No
27 (2010)	Continue development of a comprehensive River Flood Response System for New Alexandria/Belle View and Huntington in partnership with the National Weather Service and the U.S. Army Corps of Engineers.	Stormwater Planning	X		X		X									X	Hazard Mitigation Assistance grant funding, US Army Corp of Engineers, County Funding	June 2015	Establish working group by June 2011.	Medium	No
28 (2010)	Develop a template for emergency action plans (EAP) for dambreaks and other intense flooding incidents that incorporate the best EAP features of the jurisdictions in the Washington Metropolitan Area.	Stormwater Planning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Hazard Mitigation Assistance grant funding, County Funding	December 2011	Establish a working group to develop template by March 2011.	Medium	Yes
29 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation	Ongoing	Develop outreach materials, or identify	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
	providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.																Assistance funding,		appropriate outreach materials for dissemination by June 2011.		
36 (2006)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Office of Emergency Management	X	X	X												FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No
30 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Office of Emergency Management	X	X	X												FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
31 (2010)	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Office of Emergency Management	X	X	X												FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
32 (2010)	Encourage public and private water conservation plans, including consideration of rainwater catchment system.	Park Authority						X									County funding	January 2013	Engage in public outreach regarding water conservation by January 2012.	Low	Yes
33 (2010)	Work with the Virginia Department of Forestry to review local zoning and subdivision ordinances to identify areas to include wildfire mitigation principles.	Park Authority							X								Hazard Mitigation Assistance grant funding	December 2012	Establish working group by December 2011.	Low	Yes



IV. Loudoun County

Loudoun County was established in 1757 and was formerly part of Fairfax County. It was named after John Campbell, Forth Earl of Loudoun and past Governor of the Commonwealth of Virginia. It was the most populous county in Virginia during the time of the American Revolution. Since 1757, the county seat has always been Leesburg. In 2010, Loudoun County was ranked by Forbes as America's wealthiest county. The County has a total area of 521 square miles, of which one square mile is water. As of the 2000 Census, it has a population density of 272 persons per square mile. The population was estimated to be approximately 298,113 in 2009 by the U.S. Census Bureau, a nearly 76% increase over the 2000 population of 169,599. Based on the 2005-2009 American Community Survey, the county population was comprised of 73.2% white, 7.8% black or African American, 0.1% Native American, 0.1% Pacific Islander, 12.2% Asian, 3.9% from other races, and 2.7% bi-racial. Hispanics or Latinos of any race were 10.1% of the total population.



Geographically, Loudoun County is bounded to the North by the Potomac River; to the south by Prince William and Fauquier counties; and on the west by the watershed of the Blue Ridge Mountains. The Bull Run Mountains and Catoctin Mountain run through the County. There are seven incorporated and 60 unincorporated towns within the County.

Loudoun County has a moderate climate. The average annual temperature is approximately 58 degrees. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 38 inches of rain and 20 inches or so of snow fall in any given year. The wettest month on average is May. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Risk factors for the county are in part due to its proximity to the Nation's capital and its growth rate. The county has a risk of flooding due to low lying areas surrounding the Potomac River and other natural hazards and risks, such as storm damage and winter weather. Winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Loudoun County, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA's NCDC⁴¹. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;



- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, Winter Weather and Drought hazards were ranked as ‘High’ for Loudoun County. See Table 7.17 for a summary of hazard rankings.

Table 7.17: Hazard Ranking for Loudoun County									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	High	Med	Med-High	Med-Low	Med-Low

Annualized loss statistics for Loudoun County based on NCDC historical data as the result of those hazards considered to be ‘High’ (Drought, Flood, High Wind, Tornado and Winter Storm) are summarized in Table 7.18. Annualized losses for the County total to nearly \$900,000 for all natural hazards examined.

Table 7.18: NCDC Annualized Loss by Hazard for Loudoun County						
Annualized Loss as Determine through NCDC Data <i>(based on property and crop damages and number of years of record)</i>						
	Drought	Flood	High Wind	Tornado	Winter Storm	Total Annualized Losses (All Hazards)
<i>Years of Record</i>	17	17	21	59	17	
Loudoun County	\$351,549	\$216,429	\$176,618	\$119,785	\$31,982	\$896,364

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses. Much of the NCDC data is gathered from damage reports and insurance records.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Loudoun County based on HAZUS^{MH} runs for flood, hurricane, and earthquake are found in Tables 7.19, 7.20, and 7.21 below.



Table 7.19: HAZUS ^{MH} - Annualized Loss Due to Flood for Loudoun County								
Jurisdiction	Building Loss	Content Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Loss
Loudoun County	\$10,332,000	\$7,935,000	\$105,000	\$7,000	\$1,000	\$1,000	\$11,000	\$18,392,000

Table 7.20: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Loudoun County								
Jurisdiction	Building Loss	Content Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Loss
Loudoun County	\$242,275	\$20,143	\$435	\$12,197	\$1,113	\$4,444	\$1,341	\$281,948

Table 7.21: HAZUS ^{MH} - Annualized Loss Due to Earthquake for Loudoun County	
Jurisdiction	Annualized Loss
Loudoun County	\$222,490

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects is more than \$18.3 million for flooding, \$281,948 for hurricane and \$281,948 for earthquake. Although somewhat rare, earthquakes occasionally occur in the region. That was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland shook the area.

A. Loudoun County Mitigation Actions and Action Plan



#	Agency/Department : Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority
1 (2010)	Meet with VDOT and develop a plan for adding flooding signage and gates for known trouble spots	Office of Emergency Management/Loudoun County Sheriff's Office	X		X		X										Internal county funding, Federal Highway Administration grants Tiger Grants	2013	Within ninety days of endorsement of the plan have our kick-off meeting – within six months of our kick-off meeting have identified and vetted locations for action. Remaining period of time to identify funding sources and complete installation.	High



3 (2006)	Collaboration with VDOT and law enforcement in developing a strategy for installation of back-up power capabilities at key intersections in Loudoun County.	Office of Emergency Management/Loudoun County Sheriff's Office	X	X	X	X	X										Internal county funding, Federal Highway Administration grants Tiger Grants	2013	Within ninety days of endorsement of the plan have our kick-off meeting – within six months of our kick-off meeting have identified and vetted locations for action. Remaining period of time to identify funding sources and complete installation.	High
2 (2010)	Evaluate Repetitive Loss and Severe Repetitive Loss properties within the County. Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using	Office of Emergency Management	X		X		X									FEMA Unified Hazard Mitigation Assistance Grants Hazard Mitigation Grant Program Repetitive Flood Claims Severe Repetitive Loss	Ongoing	Property owner interest and application to participate in FEMA grant program	High	



	FEMA HMA programs where appropriate.																			
3 (2010)	Maintain NFIP Ordinance	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance Grants Hazard Mitigation Grant Program Repetitive Flood Claims Severe Repetitive Loss	Ongoing	Property owner interest and application to participate in FEMA grant program	High
4 (2010)	Collaboration with VDOT, transportation officials and law enforcement to develop a strategy for installation of permanent variable message boards for public messaging and traffic cameras for maintaining situational awareness.	Office of Emergency Management/Loudoun County Sheriff's Office	X	X	X	X	X										Internal county funding, Federal Highway Administration grants Tiger Grants	2015	Within ninety days of endorsement of the plan have our kick-off meeting – within six months of our kick-off meeting have identified and vetted locations for action. Remaining period of time to identify funding sources	Medium



5 (2010)	Research possible vulnerable population registration systems to better identify and serve at risk citizens	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Department of Homeland Security grants, UASI funding, county funding	2012	Continue ongoing work in this area. Within one year of endorsement of the plan be able to identify possible solutions and spend the remaining period of time working to identify funding sources to complete the project.	Medium
8 (2006)	Maintain high quality aerial photography of the County.	Office of Mapping/Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Department of Homeland Security grants, UASI funding, county funding	On-going	Continue to work with our local officials in stressing the importance of this initiative and identify funding to maintain the current capabilities.	Low (Currently being done, but need to ensure it continues to be funded).



V. Prince William County



Prince William County was formed in 1730, and was named by the Virginia General Assembly to honor the son of King George II. The county seat is the City of Manassas. Prince William County has a total area of 338 square miles, of which 11 square miles are water. It has a population density of 819 persons per square mile. In 2009, the population was estimated at 386,934, approximately a 38% increase over the 2000 census. It was the fourth fastest growing county in the United States during that period. Based on the 2005-2009 American Community Survey, the county population was comprised of 60.9% white, 19.4% black or African American, 0.5% Native American, 0.1% Pacific Islander, 6.9% Asian, 9.2% from other races, and 3.1% bi-racial. Hispanics or Latinos of any race were 18.5% of the total population.

Prince William County has a moderate climate. The average annual temperature is approximately 58 degrees. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 38 inches of rain and 16 inches of snow fall in any given year. The wettest month on average is May. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Prince William County has grown more than 200% over a 20-year period. This is because of its central location to the Washington, DC, metropolitan area. Population growth rate poses another risk; as open land is developed flood management must be addressed with the increasing amounts of impervious surfaces. Flood risk is also due to low lying areas surrounding the Potomac River. Other natural hazards and risks are storm damage and winter weather. Winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Prince William County, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA's NCDC⁴². Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of 'Low'; 'Medium-Low'; 'Medium'; 'Medium-High'; or 'High'. Based on this methodology, Flood, Wind, Tornado, and Winter Weather hazards were ranked as 'High' for Prince William County. See Table 7.22 for a summary of hazard rankings.



Table 7.22: Hazard Ranking for Prince William County								
Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
High	High	High	High	High	Med	Med-Low	Med	Med-Low

Annualized loss statistics for Prince William County based on NCDC historical data as the result of Flood, High Wind, Tornado, and Winter Storm are summarized in Table 7.23.

Table 7.23: NCDC Annualized Loss by Hazard for Prince William County						
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)						
	Drought	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss (for all hazards)
<i>Years of Record</i>	17	17	21	59	17	
Prince William County	\$114,402	\$155,044	\$795,511	\$117,080	\$60,502	\$1,242,539

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses. Much of the NCDC data is gathered from damage reports and insurance records.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Prince William County based on HAZUS^{MH} runs for flood, hurricane and earthquake are found in Tables 7.24, 7.25, and 7.26 below.

Table 7.24: HAZUS ^{MH} - Annualized Loss Due to Flood for Prince William County								
Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized
Prince William County	\$8,715,000	\$6,546,000	\$98,000	\$1,000	\$0	\$0	\$8,000	\$15,368,000

Table 7.25: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Prince William County								
Jurisdiction	Building Loss	Content Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Loss
Prince William County	\$423,454	\$34,613	\$427	\$24,402	\$1,736	\$9,219	\$2,155	\$496,004



Table 7.26: HAZUS^{MH} - Annualized Loss Due to Earthquake for Prince William County

Jurisdiction	Annualized Loss
Prince William County	\$304,948

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects is extremely high at more than \$15,368,000 for flooding and more than \$496,004 for hurricane. Earthquakes occasionally occur in the region. That was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland, shook the area.

A. Prince William County Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Compl- -etion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Evaluate vulnerability and redundancy of communication towers in the County.	Office Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance Grants Hazard Mitigation Grant Program – 5% initiative funds Note: this may be an eligibility stretch, might be something the provider should be doing as a contractual obligation e.g. address at contract renewal.	July 2011	Review communication vendor contracts regarding liability and redundancy requirements. Prioritize evaluation and COOP for communications to determine needs.	Critical	No
2 (2010)	Evaluate Repetitive Loss Properties within the County.	Office Emergency Management , Planning or Housing	X		X		X										FEMA Unified Hazard Mitigation Assistance Grants Hazard Mitigation Grant Program Repetitive Flood Claims Severe Repetitive Loss	Ongoing	Property owner interest and application to participate in FEMA grant program	High	No
3 (2010)	Educate those citizens who are at risk of minor flooding (through cooperative extension or a homeowner’s mitigation kit/checklist).	Office Emergency Management , Department of Public Works	X		X		X										FEMA Unified Hazard Mitigation Assistance Grants Hazard Mitigation Grant Program – 5% initiative funds	December 2013	Survey, tracking of website “hits.”	High	No
4 (2010)	Policy for response vehicles operating in high winds.	Office Emergency Management		X	X	X	X										No cost –internal staff support	January 2012	Adherence to revised policy.	High	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Compl- -etion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
5 (2010)	Planning for Dams, this includes evaluating county owned facilities, inundation mapping for Lake Jackson and working with private owners on inspections, maps and updates.	Department of Public Works	X		X		X					X					Hazard Mitigation Grant Program – 5% initiative funds Virginia Floodplain Management Fund (administered by DCR Division of Dam Safety and Floodplain Management) Prince William storm water utility tax funds (may require change in policy of use of funds)	July 2014	Continue to prioritize dam sites and work to secure funding. RE-evaluate annually.	High	No
6 (2010)	Evaluate schools capabilities and capacity for sheltering and emergency power.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal	December 2013	Develop priority list for evaluation. Seek funding sources.	High	No
7 (2010)	Evaluate parent notification processes at schools to include language evaluation.	Office Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	No cost –internal staff support	July 2011	Survey neighboring school districts for similar policies and processes to determine available approaches, lessons learned.	Medium	No
8 (2010)	Assess the need and or benefits for purchasing reverse 911.	Office Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal staff support Reverse 911 system; FEMA Unified Hazard Mitigation Assistance Grants Hazard Mitigation Grant Program – 5% initiative funds. Some local match likely required. Note: this was done for Northern Neck PDC and Wise County through this funding source	July 2013	Evaluate need. Prepare HMGP 5% application to be “ready” for next HMGP funding cycle.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Compl- etion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
9 (2010)	Development of a storm water inventory framework/monitoring system.	Department of Public Works	X		X		X					X					Possible Water Quality Improvement Act funds, revolving loan funds, Section 319 NPS grants from DCR.	December 2012	Develop inventory database or system Complete interim evaluation	Medium	No
10 (2010)	Remediate Dale Blvd for flooding issues.	Department of Public Works	X		X		X					X					Cooperative funding through VDOT, HMGP	July 2014	Develop preferred alternative design and prepare for permits, construction.	Medium	No
11 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
12 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No
7 (2006)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Compl- etion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
	standards, upgrade of electrical panels to accept generators, etc.																				
13 (2010)	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Office of Emergency Management	X		X		X										Prince William County floodplain management program	Ongoi ng	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No
14 (2010)	Review and update Debris Management Plan as necessary.	Department of Public Works	X	X	X	X						X				X	Internal staff; Contractual resources	Decem ber 2015	N/A	Low	No



VI. City of Fairfax

The area encompassing the City of Fairfax was originally settled in the early 18th century by farmers originating from the Virginia Tidewater area. Fairfax was incorporated as a town in 1805 and as an independent city in 1961. The city is home to George Mason University. Its population was 21,498 as of the 2000 Census and was estimated by the Census Bureau to be 24,702 in 2009. Based on the 2005-2009 American Community Survey, the city population was comprised of 72.5% white, 5.3% black or African American, 0.5% Native American, 0.2% Pacific Islander, 15.2% Asian, 3.2% from other races, and 3.2% bi-racial. Hispanics or Latinos of any race were 13.6% of the total population.



The City of Fairfax has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 40 inches of rain and 15 or more inches of snow fall in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

The city’s location on the eastern edge of the Virginia piedmont make it susceptible to other natural hazards and risks, such as storm damage and winter weather, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including the City of Fairfax, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA’s NCDC⁴³. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Wind, Tornado, and Winter Weather hazards were ranked as ‘High’ for Fairfax. See Table 7.29 for a summary of hazard rankings.

Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	Med-High	Med	Med-Low	Med	Med-Low



Annualized loss statistics for the City of the Fairfax based on NCDC historical data as the result of Flood, High Wind, Tornado, and Winter Storm are summarized in Table 7.30.

Table 7.30: NCDC Annualized Loss by Hazard for City of Fairfax					
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)					
	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss
<i>Years of Record</i>	17	21	59	17	
City of Fairfax	\$0	\$4,482	\$0	\$0	\$4,482

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Fairfax based on HAZUS^{MH} runs for flood, hurricane, and earthquake are found in Tables 7.31 and 7.32 below.

Table 7.31: HAZUS ^{MH} - Annualized Loss Due to Hurricane for City of Fairfax								
Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
City of Fairfax	\$45,380	\$5,279	\$98	\$3,158	\$731	\$1,460	\$770	\$56,876

Table 7.32: HAZUS ^{MH} - Annualized Loss Due to Earthquake for City of Fairfax	
Jurisdiction	Annualized Loss
City of Fairfax	\$49,175

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects is substantial. Earthquakes occasionally occur in the region; that was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland shook the area.

A. City of Fairfax Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Secure funding and conduct a safety analysis of the tank farm within the City. Consider hardening the facility.	Office of Emergency Management														X	UASI funding, FEMA Unified Hazard Mitigation Assistance Grants Hazard Mitigation Grant Program	January 2012	Secure funding by July 2011.	Critical	No
2 (2010)	Conduct a commodity flow survey (regionally).	Office of Emergency Management	X	X	X	X	X			X	X					X	UASI funding	December 2012	Secure funding by June 2011.	High	No
2 (2006)	Identify and prioritize the stormwater management drainage issues.	Department of Public Works	X		X		X										Possible Water Quality Improvement Act funds, revolving loan funds, Section 319 NPS grants from DCR.	December 2014	Develop comprehensive list of stormwater issues to prioritize by December 2012.	High	No
3 (2010)	Develop and disseminate an ambulance wind policy, delineating top wind speeds that ambulances can safely function in.	Office of Emergency Management		X	X	X	X										City funding	June 2011	Draft initial policy for review by February 2011.	High	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
4 (2010)	Catalog the City's critical facilities and create a GIS layer.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UASI funding	January 2013	Create committee and team to complete infrastructure survey by April 2012.	High	No
7 (2006)	Consider becoming members of the Community Rating System.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance Grants	December 2014	Secure funding by January 2011.	High	No
5 (2010)	Identify and secure funding to conduct a generator cost estimate for city shelters.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance Grants	December 2014	Secure funding by January 2011.	Medium	No
6 (2010)	Consider posting permanent evacuation signs on City-operated evacuation routes.	Office of Emergency Management	X	X	X	X	X		X	X		X				X	FEMA Unified Hazard Mitigation Assistance Grants	June 2013	Identify where, and how many, signs will be needed by January 2012.	Medium	No
7 (2010)	Conduct a generator assessment, and secure funding for generators, at City utility facilities.	Office of Emergency Management, Department of Public Works	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance Grants	December 2013	Secure funding by Jan	Medium	No
8 (2010)	Conduct a public outreach campaign using signage on city buses.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance Grants	January 2012	Secure funding for advertisements by January 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
9 (2010)	Utilize CERT team to help businesses write disaster plans.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal funding	January 2013	Develop plan to direct actions of the CERT by January 2011.	Medium	No
10 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
11 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
12 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
13 (2010)	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Office of Emergency Management	X		X		X										City funding.	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No
14 (2010)	Conduct a public outreach campaign educating the public on how registering on the Do Not Call List removes you from Reverse 9-1-1.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Reverse 911 system; FEMA Unified Hazard Mitigation Assistance Grants Hazard Mitigation Grant Program – 5% initiative funds	June 2014	Identify various methods of outreach by June 2012.	Low	No



VII. City of Falls Church

The area now known as Falls Church was originally settled in the late 17th century by European colonists who shared the site with the local Native American population. The settlement was centered on the Anglican Falls Church, which was completed in 1734. In 1948, the township broke ties with Fairfax County to become an independent city. The population of the city was 10,377 as of the 2000 Census and was estimated by the Census Bureau to be 11,711 in 2009. Based on the 2005-2009 American Community Survey, the city population was comprised of 79.1% white, 5.1% black or African American, 0.1% Native American, 10% Asian, 3.1% from other races, and 2.5% bi-racial. Hispanics or Latinos of any race were 9.4% of the total population. Falls Church has a significant Vietnamese-American population.



Falls Church has a moderate climate. The average annual temperature is approximately 58 degrees. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 40 inches of rain and 14 to 16 inches of snow fall in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

The City of Falls Church comprises about 2.2 square miles located approximately 10 miles west of Washington, DC. Falls Church's location in the Washington metropolitan area and its ease of access by car and public transportation have allowed increasingly-varied residential and commercial development. Falls Church is densely populated with more than 5,189 persons per square mile.

Falls Church experiences significant flood threats due to the presence of Four Mile Run and Tripps Run. The City's location on the eastern edge of the Virginia Piedmont make it susceptible to other natural hazards and risks, such as damage from severe storms and winter weather, as evidenced during the 2009 – 2010 winter and summer seasons. Falls Church has been declared a Federal disaster area six times since 1965 for hurricane, severe storm, and winter weather events.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Falls Church, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA's NCDC⁴⁴. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.



The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, and Winter Weather hazards were ranked as ‘High’ for City of Falls Church. See Table 7.33 for a summary of hazard rankings.

Table 7.33: Hazard Ranking for Falls Church									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	Med-High	High	Med	Med-Low	Low	Low	Low

Annualized loss statistics for City of Falls Church based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.34.

Table 7.34: NCDC Annualized Loss by Hazard for City of Falls Church					
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)					
	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss (All Hazards)
<i>Years of Record</i>	17	21	59	17	
Falls Church	\$53,959	\$198,830	\$88,210	\$60,484	\$492,138

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Falls Church based on HAZUS^{MH} runs for hurricane and earthquake are found in Tables 7.35 and 7.36 below.

Table 7.35: HAZUS ^{MH} - Annualized Loss Due to Hurricane for City of Falls Church								
Jurisdiction	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Total
Falls Church	\$29,561	\$3,820	\$36	\$2,127	\$401	\$1,034	\$488	\$37,468

Table 7.36: ^{MH} - Annualized Loss Due to Earthquake for City of Falls Church	
Jurisdiction	Annualized Loss
City of Falls Church	\$20,589



As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects is more than \$37,000 for hurricanes. Earthquakes occasionally occur in the region; that was the case July 16, 2010 when a 3.6 magnitude quake centered near Gaithersburg, Maryland shook the area.

A. City of Falls Church Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Comple- tion Date	Interim Measure of Success	Priority	Keep Action Red- acted (Yes/No)
1 (2010)	Cross training of bus drivers to operate snow removal equipment	Falls Church City Public Schools		X													Falls Church Public Works	2012	Evaluation after first significant snow event.	High	No
2 (2010)	Evaluate the need for and acquire snow removal equipment	Falls Church City Public Schools		X													Fall Church Public Works	2012	Needs assessment in initial budget process.	Medium	No
3 (2010)	Examine feasibility for and acquire structure (if feasible) to provide covered parking for school buses	Falls Church City Public Schools		X	X	X	X										Falls Church School Board	2012	Needs assessment in initial budget process.	Low	No
4 (2010)	Evaluate the need for and acquire vacuum truck (used for flooding)	Falls Church Department of Environmental Services	X														City of Falls Church general revenue funds	2012	Needs assessment in initial budget process.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Comple- tion Date	Interim Measure of Success	Priority	Keep Action Red- acted (Yes/No)
5 (2010)	Evaluate potential contractors for providing resources (human and otherwise) to assist during emergencies	Falls Church Department of Environmental Services	X	X	X	X	X	X	X	X	X	X	X	X	X	X	City of Falls Church general revenue funds FEMA – VDEM Public Assistance funds (reimbursement) for qualified presidential emergency or disaster declarations for Public Assistance Categories A (Debris) and B (Emergency Preparedness Activities).	2013	Needs assessment for budgeting purposes by 2011, procurement and contract in place by 2013.	Medium	No
2 (2006)	Evaluate adding staffing resources to operate AM radio station (used for alerting residents to hazards, relaying info)	Falls Church Police Department?	X	X	X	X	X	X	X	X	X	X	X	X	X	X	City of Fairfax general revenue funds EMPG DHS FEMA – VDEM Public Assistance Category B funds	2011	Staffing analysis of internal staff (volunteers) and external supplemental or contractual staff.	Low	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Comple- tion Date	Interim Measure of Success	Priority	Keep Action Red- acted (Yes/No)
6 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, and flood insurance information) that can assist them in reducing their flood risk.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
7 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Identify all priority flood- prone structures by December 2011.	Medium	No
8 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Comple- tion Date	Interim Measure of Success	Priority	Keep Action Red- acted (Yes/No)
9 (2010)	Review Falls Church compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Office of Emergency Management	X		X		X										Falls Church general funds	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No



VIII. City of Manassas



The City of Manassas is an independent city in the Commonwealth of Virginia and covers an area 10 square miles. The jurisdiction grew from a crossroads after the Civil War, and was incorporated in 1873. The city was the staging ground for the First Battle of Manassas in 1861, also known as First Battle of Bull Run. Originally it was called Manassas Junction for its strategic railroad location leading to Richmond, Washington, DC, and the Shenandoah Valley. Modern history has seen increased development due to its proximity to Washington, DC. The population of the city was 35,135 as of the 2000 Census and was estimated by the Census Bureau to be 36,213 in 2009. Based on the 2005-2009 American Community Survey, the city population was comprised of 65.6% white, 11.4% black or African American, 0.2% Native American, 4.1% Asian, 14.5% from other races, and 4.2% bi-racial. Hispanics or Latinos, of any race, represent 27.2% of the total population.

Manassas has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 38 inches of rain and 16 inches of snow fall in any given year. The wettest month on average is May. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Manassas is subject to high wind events, winter weather, and flooding. Winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season. The city has instituted a winter weather preparation program.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Manassas, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA’s NCDC⁴⁵. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, and Winter Weather hazards were ranked as ‘High’ for Manassas. See Table 7.37 for a summary of hazard rankings.

Table 7.37: Hazard Ranking for City of Manassas								
Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
High	High	High	High	Med-High	Med	Med-Low	Med-Low	Med-Low



Annualized loss statistics for Manassas based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.38.

Table 7.38: NCDC Annualized Loss by Hazard for City of Manassas					
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)					
	Flood	High Wind	Tornado	Winter Storm	Total Annualized
<i>Years of Record</i>	17	21	59	17	Loss (for all hazards)
City of Manassas	\$89,084	\$694,402	\$0	\$60,502	\$958,390

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses. Much of the NCDC data is gathered from damage reports and insurance records.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Manassas based on HAZUS^{MH} runs for hurricane and earthquake are found in Tables 7.39 and 7.40 below.

Table 7.39: HAZUS^{MH} - Annualized Loss Due to Hurricane for City of Manassas								
Jurisdiction	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Total
City of Manassas	\$62,939	\$6,288	\$115	\$3,899	\$396	\$1,534	\$667	\$75,838

Table 7.40: HAZUS^{MH} - Annualized Loss Due to Earthquake for City of Manassas	
Jurisdiction	Annualized Loss
City of Manassas	\$53,204

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects is just under \$76,000 for hurricane and just over \$53,000 for earthquake. Although somewhat rare, earthquakes occasionally occur in the region. That was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland shook the area.

A. City of Manassas Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Evaluate Repetitive Loss and Severe Repetitive Loss properties within the City. Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Emergency Management	X	X	X		X					X					FEMA Unified Hazard Mitigation Assistance	12/31/2005	Obtain funding	High	No
2 (2010)	Shelter back up power evaluation Generator Plan for the 4 shelter sites currently identified	City of Manassas Public Schools with support from Public Works and Utilities	X	X	X	X	X									X	FEMA HMA Grants DHS grants for critical infrastructure City of Manassas funds	1/1/2015	Generator plan for half of the sites identified	Medium	No
3 (2010)	Developing Strategic National Stockpile procedure and policies and conduct drills/exercises	Schools and Health Department	X	X	X	X	X			X		X				X	DHS grants City of Manassas funds	1/1/2015	Development of policies	Medium	No
4 (2010)	Exercise and training for mass sheltering (animal and human)	City of Manassas Public Schools	X	X		X	X			X		X		X	X	X	DHS grants EMPG funds City of Manassas funds	1/1/2015	Committing to a date in which to conduct the training	Medium	No
5 (2010)	Train required City staff on NIMS/ICS	All agencies															EMPG	1/1/2015	Annual staff	Low	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
																			certifications		
6 (2010)	Risk analysis on all schools	City of Manassas Public Schools	X	X	X	X	X	X	X	X	X	X	X	X	X	X	DHS Department of Education	1/1/2015	A plan in place for conducting the analyses	High	No
7 (2010)	Evaluate need for and purchase additional weather radios for the schools	City of Manassas Public Schools	X	X	X	X	X	X	X	X	X	X		X		X	N/A	11/30/2011		High	No
8 (2010)	Purchase weather radio for EOC	EM	X	X	X	X	X	X	X	X	X	X		X		X	N/A	11/30/2011		High	No
9 (2010)	Expand communications and notification participation through public outreach	Emergency Management; Citizen Corps or CERT volunteers	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Staff and volunteer resources	1/1/2015	Complete outreach plan Prioritize outreach efforts Implement outreach to priority stakeholder/citizen groups Development of marketing materials	Medium	No
10 (2010)	Educate citizens on use of reverse 9-11	Emergency Management; Citizen Corps or CERT volunteers	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Staff and volunteer resources	1/1/2015	Prioritize stakeholder groups for 911 outreach effort	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
11 (2010)	Cross train staff across departments to support critical functions	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	County staff resources	1/1/2015	Develop a plan for cross training staff	Medium	No
12 (2010)	Use CERT resources to educate and develop emergency plans, protocols etc...	Emergency management CERT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Emergency Management CERT	Ongoing – within 5 years	Prioritization of necessary plans to develop	Medium	No
13 (2010)	Update flood inundation maps	Contractual support	X				X					X					FEMA Risk MAP County funds	1/1/2015	Develop a plan (including schedule) for updating maps	Low	No
14 (2010)	Conduct Local Emergency Management Operations Course (LEMOC)	Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X		February 24, 2011	Finalized course materials/topics	High	No



IX. City of Manassas Park

The City of Manassas Park was incorporated in 1957 and became an independent city in 1975. It was the last town in Virginia to become a city before a moratorium was placed on other towns achieving similar status. The population of the city was 10,290 as of the 2000 Census and was estimated by the Census Bureau to be 14,026 in 2009. Based on the 2005-2009 American Community Survey, the city population was comprised of 62.9% white, 11.1% black or African American, 0.4% Native American, 6.4% Asian, 16.7% from other races, and 2.6% bi-racial. Hispanics or Latinos, of any race, represent 30.4% of the total population.



The City of Manassas Park is seeing population growth with new residents focusing on the city center in new densely configured housing units. While traditional residents live in less dense areas in older dwellings.

The City of Manassas Park has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 38 inches of rain and 16 inches of snow fall in any given year. The wettest month on average is May. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

The City of Manassas Park is subject to high wind events and extreme winter weather. Winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Manassas Park, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA's NCDC⁴⁶. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of 'Low'; 'Medium-Low'; 'Medium'; 'Medium-High'; or 'High'. Based on this methodology, Flood, Wind, and Winter Weather hazards were ranked as 'High' for Manassas Park. See Table 7.41 for a summary of hazard rankings.



Table 7.41: Hazard Ranking for Manassas Park

Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	Med-High	Med-High	High	Low	Med-Low	Low	Med-Low	Low

Annualized loss statistics for the City of Manassas Park based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.42.

Table 7.42: NCDC Annualized Loss by Hazard for City of Manassas Park

Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)					
	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss (for all hazards)
<i>Years of Record</i>	17	21	59	17	
City of Manassas Park	\$0	\$573	\$0	\$0	\$573

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses. Much of the NCDC data is gathered from damage reports and insurance records.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for the City of Manassas Park based on HAZUS^{MH} runs for flood, hurricane and earthquake are found in Tables 7.43, 7.44 and 7.45 below.

Table 7.43: HAZUS^{MH} - Annualized Loss Due to Flood for City of Manassas Park

Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
City of Manassas Park	\$36,000	\$31,000	\$0	\$0	\$0	\$0	\$0	\$67,000



Table 7.44: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Manassas Park								
Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
City of Manassas Park	\$16,418	\$1,395	\$30	\$903	\$47	\$275	\$78	\$19,145

Table 7.45: HAZUS ^{MH} - Annualized Loss Due to Earthquake for City of Manassas Park	
Jurisdiction	Annualized Loss
City of Manassas Park	\$11,457

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects is moderately high at more than \$19,000 for high wind and \$67,000 for flooding. The earthquake annualized loss estimate is relatively low, but earthquakes occasionally occur in the region. That was the case July 16, 2010 when a 3.6 magnitude quake centered near Gaithersburg, Maryland shook the area.

A. City of Manassas Park Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Examine (and mitigate if necessary) the roof structure of the Community Center and Middle School to withstand winter storm loads.	Office of Emergency Management, Department of Public Works		X													FEMA Unified Hazard Mitigation Assistance Grants	July 2012	Secure funding by July 2011.	Critical	No
2 (2010)	Continue to develop and finalize the City's stormwater management plan.	Department of Public Works	X	X	X		X										Internal funding, Possible Water Quality Improvement Act funds, revolving loan funds, Section 319 NPS grants from DCR.	January 2012	Finish draft for review by July 2011.	High	No
3 (2010)	Consider implementing stormwater fees to citizens.	Department of Public Works, Office of the City Manager	X	X	X		X										Internal funding	July 2011	Develop initial fee schedule by March 2011.	High	No
4 (2010)	Identify and secure funding to rehabilitate retention ponds within the City.	Department of Public Works	X	X	x		X										FEMA Unified Hazard Mitigation Assistance Grants	December 2014	Catalog all detention ponds to be rehabilitated by December 2012.	High	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
4 (2006)	Consider executing a public outreach campaign in the City's schools to educate students about local hazards.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	No cost – internal staff support	January 2013	Develop agreement with Manassas Park Public Schools to distribute educational fliers by January 2012.	High	No
5 (2010)	Exercise the Reverse 9-1-1 system City-wide.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UASI funding	July 2014	Secure funding by July 2013.	Medium	No
4 (2006)	Display and distribute educational hazard and emergency brochures at local events where information displays exist (i.e. Fall Festival).	Office of Emergency Management, Law Enforcement	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal funding	June 2011	Ensure sufficient quantity of brochures for dissemination by March 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
4 (2006)	Distribute hazard education fliers in utility mailings at least once a year.	Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal funding	June 2011	Develop distribution schedule and identify which utility mailing to include the fliers in by May 2011.	Medium	No
6 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, and flood insurance information) that can assist them in reducing their flood risk.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
7 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding,	Ongoing	Identify all priority flood-prone structures by Dec. 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
7 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Office of Emergency Management	X		X		X										FEMA Unified Hazard Mitigation Assistance funding.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
8 (2010)	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Office of Emergency Management	7		X		X										Internal program support.	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No
9 (2010)	Distribute hazard education fliers at HOA meetings that are attended by City representatives, at least once a year.	Office of Emergency Management, Law Enforcement	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal funding	June 2011	Schedule attendance at one HOA meeting by April 2011.	Low	No



X. Town of Clifton

Formerly known as Devereux Station, Clifton became the first town in Fairfax County when it incorporated on March 9, 1902. The population of the town was 185 as of the 2000 Census and was estimated by the Census Bureau to be 216 in 2009. Based on the 2005-2009 American Community Survey, the town population was comprised of 97.3% white, 0.7% Asian, 1% from other races, and 1% bi-racial. Hispanics or Latinos, of any race, represent 4.7% of the total population.



The Town of Clifton has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 36 inches of rain and 15 or more inches of snow fall in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

The town’s location on the eastern edge of the Virginia Piedmont make it susceptible to other natural hazards and risks, such as storm damage and winter weather, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including the Town of Clifton, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA’s NCDC⁴⁷. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, and Winter Weather hazards were ranked as ‘High’ for the Town of Clifton. See Table 7.46 for a summary of hazard rankings.

Table 7.46: Hazard Ranking for the Town of Clifton									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	Med-High	Med	Med-Low	Med	Med-Low



Annualized loss statistics for Fairfax County (which includes the Town of Clifton) based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.47. The NCDC only reports losses for hazards at the city and county level.

Table 7.47: NCDC Annualized Loss by Hazard for Fairfax County					
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)					
	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss
<i>Years of Record</i>	17	21	59	17	
Fairfax County	\$801,903	\$612,562	\$2,265,041	\$60,537	\$3,830,698

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for the Town of Clifton based on HAZUS^{MH} runs for flood, hurricane, and earthquake are found in Tables 7.48, 7.49, and 7.50 below.

Table 7.48: HAZUS ^{MH} - Annualized Loss Due to Flood for the Town of Clifton								
Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
Town of Clifton	\$27,000	\$47,000	\$2,000	\$0	\$0	\$0	\$0	\$76,000

Table 7.49: HAZUS ^{MH} - Annualized Loss Due to Hurricane for the Town of Clifton								
Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
Town of Clifton	\$504	\$36	\$0	\$22	\$3	\$7	\$12	\$584

Table 7.50: HAZUS ^{MH} - Annualized Loss Due to Earthquake for the Town of Clifton	
Jurisdiction	Annualized Loss
Town of Clifton	\$475



As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects due to hurricanes is minimal, due to the Town of Clifton's size. Earthquakes occasionally occur in the region; that was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland, shook the area.

A. Town of Clifton Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Assess the roadway structure at various intersections throughout the Town of Clifton to avoid repeated flooding.	Police Department	X		X		X										Hazard Mitigation Assistance grant funding, County funding	December 2015	Identify funding sources by January 2012	High	No
2 (2010)	Continue to identify and employ a broad range of warning systems throughout the Town of Clifton.	Police Department	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UASI funding, DHS grants, town/county funding	December 2015	Identify one new warning system to utilize by December 2012.	High	No
3 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, and flood insurance information) that can assist them in reducing their flood risk.	Police Department	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
4 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Police Department	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
5 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Police Department	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
6 (2010)	Review Town of Clifton's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Police Department	X		X		X										General funds	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No



XI. Town of Dumfries

Located in Prince William County, Dumfries was chartered on May 11, 1749, and is Virginia's oldest continuously chartered town. John Graham gave the land on which the town was founded and it is named after his birthplace, Dumfrieshire, Scotland. The population of the town was 4,937 as of the 2000 Census and was estimated by the Census Bureau to be 4,954 in 2009. Based on the 2005-2009 American Community Survey, the town population was comprised of 47.6% white, 31.4% black or African American, 0.7% Native American, 2.8% Asian, 12.9% from other races, and 4.6% bi-racial. Hispanics or Latinos, of any race, represent 27.4% of the total population.



Dumfries has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 39 inches of rain and 16 or more inches of snow fall in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Dumfries is also subjected to tidal and storm surge flooding, due to the town's location below the Fall Line on Quantico Creek. As sea levels rise, permanent inundation of low lying areas along and near the river shoreline is also a concern. Dumfries is also susceptible to other natural hazards and risks, such as storm damage and winter weather, as evidenced during the 2009 – 2010 winter and summer seasons.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Dumfries, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA's NCDC⁴⁸. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of 'Low'; 'Medium-Low'; 'Medium'; 'Medium-High'; or 'High'. Based on this methodology, Flood, Wind, Tornado, Winter Weather, and Drought hazards were ranked as 'High' for Dumfries. See Table 7.51 for a summary of hazard rankings.



Table 7.51: Hazard Ranking for Town of Dumfries									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	High	Med	Med-Low	Med	Med-Low

Annualized loss statistics for Prince William County based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.52.

Table 7.52: NCDC Annualized Loss by Hazard for Prince William County					
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)					
	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss (All Hazards)
<i>Years of Record</i>	17	21	59	17	
Prince William County	\$155,044	\$795,511	\$117,080	\$60,502	\$1,242,539

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Dumfries based on HAZUS^{MH} runs for flood, hurricane, and earthquake are found in Tables 7.53, 7.54 and 7.55 below.

Table 7.53: HAZUS ^{MH} - Annualized Loss Due to Flood for Town of Dumfries								
Jurisdiction	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Total
Town of Dumfries	\$396,000	\$449,000	\$7,000	\$0	\$0	\$0	\$2,000	\$854,000

Table 7.54: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Town of Dumfries								
Jurisdiction	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Total
Town of Dumfries	\$4,441	\$451	\$4	\$392	\$23	\$191	\$41	\$5,542



Table 7.55: HAZUS^{MH} - Annualized Loss Due to Earthquake for Town of Dumfries

Jurisdiction	Annualized Loss
Town of Dumfries	\$2,492

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects due to flooding is high, due to Dumfries’s location. Earthquakes occasionally occur in the region; that was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland, shook the area.

A. Town of Dumfries Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Assess the roadway structure at various intersections throughout the Town of Dumfries to avoid repeated flooding.	Public Works	X		X		X						X				Hazard Mitigation Assistance grant funding, State funding possible, and any Grant programs	December 2015	Identify funding sources by January 2012	High	No
2 (2010)	Continue to implement an effective MS-4 Program which will bring awareness to help prevent hazardous waste material being flushed down the drain or into ditches.	Public Works														X	Environmental Friendly funding, EPA grants, town/county funding, and fee based funding	December 2015, but mainly an ongoing program	Identify all drainage outfalls and have them electronically uploaded on a data base by December 2011.	High	No
3 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, and flood insurance information) that can assist them in reducing their flood risk.	Building official with assistance from Zoning Director	X	X		X											FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
4 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs	Public Works in conjunction with Zoning Department	X	X		X											FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No

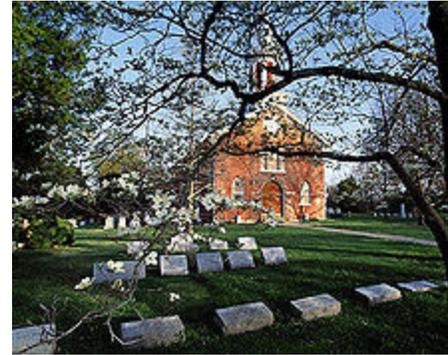


#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
	where appropriate.																				
5 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Public Works	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
6 (2010)	Review Town of Dumfries' compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Public Works, Zoning Departments	X		X		X										General funds	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No
7 (2010)	Continue to identify and employ a broad range of warning systems throughout the Town of Dumfries.	Town of Dumfries Police Department	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UASI funding, DHS grants, town/county funding	December 2015	Identify one new warning system to utilize by December 2012.	Low	No



XII. Town of Haymarket

Located near Civil War Battlefields and on the “Journey Through Hallowed Ground,” the Town of Haymarket is an important historical site as well as a growing destination for shoppers and history buffs. Chartered in 1799 by the Virginia General Assembly, the Town of Haymarket was incorporated in 1882. The population of the town was 879 as of the 2000 Census and was estimated by the Census Bureau to be 1,252 in 2009.



Since the 1900s it has been popular for fox hunting and steeple chasing and is also known for its wineries. The town covers .5 square miles of land and is located in Prince William County. Based on the 2005-2009 American Community Survey, the town population was comprised of 68.8% white, 17.9% black or African American, 0.4% Pacific Islander, 6.5% Asian, 5.8% from other races, and 0.7% bi-racial. Hispanics or Latinos of any race were 11.3% of the total population.

Haymarket has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 38 inches of rain and 16 inches of snow fall in any given year. The wettest month on average is May. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Haymarket is subject to high wind events and extreme winter weather. Winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Haymarket, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA’s NCDC⁴⁹. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, and Winter Weather hazards were ranked as ‘High’ for Manassas Park. See Table 7.56 for a summary of hazard rankings.



Table 7.56: Hazard Ranking for Town of Haymarket									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	High	Med	Med-Low	Med	Med-Low

Annualized loss statistics for Prince William County based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.57.

Table 7.57: NCDC Annualized Loss by Prince William County (including Town of Haymarket)					
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)					
	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss (All Hazards)
<i>Years of Record</i>	17	21	59	17	
Prince William County	\$155,044	\$795,511	\$117,080	\$60,502	\$1,242,539

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses. Much of the NCDC data is gathered from damage reports and insurance records.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Haymarket based on HAZUS^{MH} runs for hurricane and earthquake are found in Tables 7.58 and 7.59 below.

Table 7.58: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Haymarket								
Jurisdiction	Building Loss	Content Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
Town of Haymarket	\$123	\$9	\$0	\$6	\$1	\$2	\$1	\$143

Table 7.59: HAZUS ^{MH} - Annualized Loss Due to Earthquake for Haymarket	
Jurisdiction	Annualized Loss
Town of Haymarket	\$ 165



As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory, and related effects due to hurricanes is minimal, due to the Town of Haymarket's size. The earthquake annualized loss estimate is relatively low, but earthquakes occasionally occur in the region. That was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland shook the area.

A. Town of Haymarket Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Assess the roadway structure at various intersections throughout the Town of Haymarket to avoid repeated flooding.	Town of Haymarket Police Department	X		X		X										Hazard Mitigation Assistance grant funding, County funding	December 2015	Identify funding sources by January 2012	High	No
2 (2010)	Continue to identify and employ a broad range of warning systems throughout the Town of Haymarket.	Town of Haymarket Police Department	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UASI funding, DHS grants, town/county funding	December 2015	Identify one new warning system to utilize by December 2012.	High	No
3 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, and flood insurance information) that can assist them in reducing their flood risk.	Town of Haymarket Police Department	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
4 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Town of Haymarket Police Department	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
5 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Town of Haymarket Police Department	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
6 (2010)	Review Town of Haymarket's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.		X		X		X										General funds	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No
7 (2010)	Assess vacant buildings, determine historical significance, and develop a plan for restoring or demolishing the buildings vulnerable to hazards.	Town of Haymarket Town Manager	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Assess at least one vacant lot per year	Low	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
8 (2010)	Participate in the region-wide Commodity Flow Survey, particularly as it relates to hazardous material transportation on railways. Develop signage to warn motorists and pedestrians at railway crossings.	Town of Haymarket Police Department														X	UASI Funding	December 2014	Identify Funding by December 2012	Low	No



XIII. Town of Herndon

Incorporated as a town in 1879, the area in Fairfax County on which Herndon was built was originally granted to Thomas Culpeper by King Charles II of England in 1688. Much of the downtown was destroyed on March 22, 1917, by a fire but was rebuilt with brick instead of wood. The population of the town was 21,655 as of the 2000 Census and was estimated by the Census Bureau to be 22,579 in 2009. Based on the 2005-2009 American Community Survey, the town population was comprised of 58.3% white, 10.6% black or African American, 2.3% Native American, 16.1% Asian, 10.3% from other races, and 2.4% bi-racial. Hispanics or Latinos, of any race, represent 27.6% of the total population.



The Town of Herndon has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 40 inches of rain and 15 or more inches of snow fall in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

The town’s location on the eastern edge of the Virginia piedmont makes it susceptible to other natural hazards and risks, such as storm damage and winter weather, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Herndon, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA’s NCDC⁵⁰. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, and Winter Weather hazards were ranked as ‘High’ for Herndon. See Table 7.60 for a summary of hazard rankings.

Table 7.60: Hazard Ranking for the Town of Herndon									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	Med-High	Med	Med-Low	Med	Med-Low



Annualized loss statistics for Fairfax County based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.61. The NCDC only reports losses for hazards at the city and county level.

Table 7.61: NCDC Annualized Loss by Hazard for Fairfax County					
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)					
	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss
<i>Years of Record</i>	17	21	59	17	
Fairfax County	\$801,903	\$612,562	\$2,265,041	\$60,537	\$3,380,698

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for the Town of Herndon based on HAZUS^{MH} runs for flood, hurricane, and earthquake are found in Tables 7.62, 7.63 and 7.64 below.

Table 7.62: HAZUS^{MH} - Annualized Loss Due to Flood for Town of Herndon								
Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
Town of Herndon	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Table 7.63: HAZUS^{MH} - Annualized Loss Due to Hurricane for Town of Herndon								
Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
Town of Herndon	\$36,459	\$4,273	\$63	\$2,429	\$456	\$1,099	\$559	\$45,338

Table 7.64: HAZUS^{MH} - Annualized Loss Due to Earthquake for Town of Herndon	
Jurisdiction	Annualized Loss
Town of Herndon	\$32,972



As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory, and related effects due to hurricanes is minimal due to the Town of Herndon's size. Earthquakes occasionally occur in the region; that was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland, shook the area.

A. Town of Herndon Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
9 (2006)	Explore the opportunity to wire the police department building at 397 Herndon Parkway, Herndon Va. 20170 for a back-up generator.	Herndon Police Department	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Hazard Mitigation Assistance grant funding, County funding	December 2015	Identify funding sources by January 2012	High	No
1 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, and flood insurance information) that can assist them in reducing their flood risk.	Public Works	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
2 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Public Works	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
3 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Public Works	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
4 (2010)	Review Town of Herndon's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Public Works	X		X		X										General funds	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No



XIV. Town of Leesburg

Steeped in history, Leesburg is the county seat of Loudoun County. Leesburg was established in 1758, and formally became a town by signed act of the Virginia General Assembly on February 18, 1813. It is located just over 30 miles west-northwest of Washington, DC, at the base of Catoctin Mountain and adjacent to the Potomac River. The principal drainage for the town is Tuscarora Creek and its northern “Town Branch,” which empties into Goose Creek located to the east of town.



European settlement began in the late 1730s. After founding, it was the location of the post office and regional courthouse. The town was originally established on 60 acres of land.

The population of the town was 28,311 as of the 2000 Census and was estimated by the Census Bureau to be 40,927 in 2009. As of the 2000 census there were 10,325 households. The population density in 2000 was 2,440 people per square mile. Based on the 2005-2009 American Community Survey, the town population was comprised of 72.8% white, 12% black or African American, 6.7% Asian, 5.2% from other races, and 3.3% bi-racial. Hispanics or Latinos of any race were 12% of the total population.

Leesburg has a moderate climate. The average annual temperature is approximately 58 degrees. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 43 inches in any given year, with approximately 20 inches of snowfall annually. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Leesburg has a rapidly growing population and is less than an hour’s car ride to Washington, DC. Risks for the town include its proximity to the Nation’s capital, its growth rate, flooding of low lying areas surrounding the Potomac River, and other natural hazards such as storm damage and winter weather. Winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Leesburg, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA’s NCDC⁵¹. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;



- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, Winter Weather and Drought hazards were ranked as ‘High’ for Leesburg. See Table 7.65 for a summary of hazard rankings.

Table 7.65: Hazard Ranking for Leesburg									
	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	High	Med	Med-High	Med-Low	Med-Low

Annualized loss statistics for Loudoun County based on NCDC historical data as the result of Flood, High Wind, Tornado, and Winter Storm are summarized in Table 7.66.

Table 7.66: NCDC Annualized Loss by Hazard for Loudoun County						
Annualized Loss as Determine through NCDC Data						
<i>(based on property and crop damages and number of years of record)</i>						
	Drought	Flood	High Wind	Tornado	Winter Storm	Total Annualized Losses (All Hazards)
<i>Years of Record</i>	17	17	21	59	17	
Loudoun County	\$351,549	\$216,429	\$176,618	\$119,785	\$31,982	\$896,364

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses. Much of the NCDC data is gathered from damage reports and insurance records.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Leesburg based on HAZUS^{MH} runs for flood, hurricane and earthquake are found in Tables 7.67, 7.68, and 7.69 below.

Table 7.67: HAZUS ^{MH} - Annualized Loss Due to Flood for Leesburg			
Jurisdiction	Building Loss	Content Loss	Total Loss
Town of Leesburg	\$474,000	\$339,000	\$813,000



Table 7.68: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Leesburg								
Jurisdiction	Building	Contents	Inventory	Relocation	Incom	Rental	Wage	Total
Town of Leesburg	\$23,601	\$1,807	\$20	\$1,312	\$160	\$612	\$233	\$27,745

Table 7.69: HAZUS ^{MH} - Annualized Loss Due to Earthquake for Leesburg	
Jurisdiction	Annualized Loss
Town of Leesburg	\$29,955

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects total to more than \$813,000 for flooding and \$27,745 for hurricane. Earthquakes occasionally occur in the region. That was the case July 16, 2010 when a 3.6 magnitude quake centered near Gaithersburg, Maryland shook the area.

A. Town of Leesburg Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Develop and test government Continuity of Operations (Coop) plans.	Town Manager / dept directors	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal Town of Leesburg	12 months from time of award	Develop plan / train staff	High	No
2 (2010)	Develop and test model evacuation and shelter-in-place plans for government facilities to include identifying and stocking shelter areas, testing notification systems	All Departments	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal town funding, U.S. Department of Homeland Security, Office of Domestic Preparedness : Homeland Security Grant Program (HSGP)	12 months from time of award	Develop evac and shelter in place plan for town facilities	Moderate	No
3 (2010)	Provide additional automation and display equipment for Emergency Operations Center (EOC). Develop means for inclusion of GIS capability to track storm-related events including road closures, traffic signal status, power outages and building damage due to storm events. Identify and train staff required to operate EOC	Police, Public Works and IT Department	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal town funding, Federal Highway Administration grants Tiger Grants, Department of Homeland Security grants, county funding	12 months after availability of funds	Identifying and purchasing needed equipment	Moderate	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
	Variable Traffic Message Signs: This project will add several traffic message boards to the town's inventory. These boards are effective in the dissemination of information in the event of an emergency. They can be programmed with various messages including general traffic rerouting information, and other emergency messages. Additionally locations will be identified and pads prepared with power for deployment	Public Works – Street Department /Police dept	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal town funding, Federal Highway Administration grants Tiger Grants, Department of Homeland Security grants, county funding	Immediately upon receipt of funding	Identify locations	Moderate	No
4 (2010)	Practical Emergency Operations Training Exercise on a town wide basis for a natural disaster.	Town Manager / Police (All Agencies)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal town funding Department of Homeland Security grants, UASI funding, county funding	Six months	Develop exercise	High	



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Compl- etion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
			X	X	X	X	X	X	X	X	X	X	X	X	X	X					
	Improve drainage in low-lying or poor drainage areas along primary and secondary roads where needed town wide. During heavy rain events, several area roadways become inundated with water runoff. Priority Projects: 1. Tuscarora Creek Improvements 2. Town Branch Improvements—King Street 3. Turner-Hardwood Drainage	Public Works, Office of Capital Projects, Planning,	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Coordinate with Virginia Department of Transportation (VDOT)	Undetermined at this point—based on funding availability	Identify funding	High	No
2 (2006)	Improve security measures as needed around critical facilities	Executive Office	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U.S. Department of Homeland Security, Office of Domestic Preparedness : Homeland Security Grant Program (HSGP); Buffer Zone Protection Program (BZPP)	Undetermined at this time—dependent on funding source and availability	Develop security enhancement plan	Moderate	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
3 (2006)	Provide back-up power (generators, where needed) for critical facilities (i.e., fire stations, police stations, water facilities, etc.).	Executive Office/ all depts.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U.S. Department of Homeland Security, Office of Domestic Preparedness : Homeland Security Grant Program (HSGP); Buffer Zone Protection Program (BZPP)	Time schedule is dependent on funding source and availability	Identify funding	Moderate	No
5 (2010)	Update Town of Leesburg citizen guide to emergency Preparedness. Mail to residents and post on web	Police/ Executive/IT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	U.S. Department of Homeland Security, Office of Domestic Preparedness : Homeland Security Grant Program (HSGP)	Time schedule is dependent on funding source and availability	Identify funding	Moderate	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
6 (2010)	Establish and full test emergency notification procedures and protocols for key government personnel to include; emergency email groups, text based alerts, pager based alerts, etc as well as establishment of Emergency call trees	Executive /All Depts	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal town funding Department of Homeland Security grants, UASI funding, county funding	Six months	Develop protocols	High	No
7 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.	Public Works	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
8 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Public Works	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
9 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Public Works	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
10 (2010)	Review Town of Leesburg's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Public Works	X		X		X										General funds	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No



XV. Town of Middleburg

The Town of Middleburg was established in 1787. The population of the town was 632 as of the 2000 Census and was estimated by the Census Bureau to be 976 in 2009. Middleburg is located in Loudoun County and covers approximately 0.6 square miles of land. The population density of the town is 1,083 people per square mile. Based on the 2005-2009 American Community Survey, the town population was comprised of 73.8% white and 26.2% black or African American. Hispanics or Latinos of any race were 0.8% of the total population.

Middleburg has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 38 inches of rain and approximately 20 inches of snow fall in any given year. The wettest month on average is May. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Middleburg is subject to high wind events and extreme winter weather. Winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Middleburg, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA’s NCDC⁵². Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, Winter Weather and Drought hazards were ranked as ‘High’ for Middleburg. See Table 7.70 for a summary of hazard rankings.

Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	High	Med	Med-High	Med-Low	Med-Low



Annualized loss statistics for Loudoun County based on NCDC historical data as the result of Flood, High Wind, Tornado, and Winter Storm are summarized in Table 7.71.

Table 7.71: NCDC Annualized Loss for Loudoun County						
Annualized Loss as Determine through NCDC Data						
<i>(based on property and crop damages and number of years of record)</i>						
	Drought	Flood	High Wind	Tornado	Winter Storm	Total Annualized Losses (All Hazards)
Years of Record	17	17	21	59	17	
Loudoun County	\$351,549	\$216,429	\$176,618	\$119,785	\$31,982	\$896,364

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses. Much of the NCDC data is gathered from damage reports and insurance records.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Middleburg based on HAZUS^{MH} runs for hurricane and earthquake are found in Tables 7.72 and 7.73 below.

Table 7.72: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Town of Middleburg								
Jurisdiction	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Total
Town of Middleburg	\$89	\$5	0	\$4	\$1	\$2	\$1	\$101

Table 7.73: HAZUS ^{MH} - Annualized Loss Due to Earthquake for Town of Middleburg	
Jurisdiction	Annualized Loss
Town of Middleburg	\$129

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects due to hurricanes is minimal, due to the Town of Middleburg’s size. Although somewhat rare, earthquakes occasionally occur in the region. That was the case July 16, 2010 when a 3.6 magnitude quake centered near Gaithersburg, Maryland shook the area.

A. Town of Middleburg Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Develop and test government Continuity of Operations Plan (COOP).	Town Administration	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal to general fund	12 months from endorsement of the plan	Develop the COOP and train staff.	High	No
2 (2010)	Develop Geographical Information System with critical layers between the town and the county.	Planning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Internal to general fund, DHS Grant Funding, Hazard Mitigation Grant Funds	12 months from endorsement of the plan	Development of GIS system and associated data for hazard mitigation.	High	No
3 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.	Planning and Zoning	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
4 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Planning and Zoning	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No
5 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Planning and Zoning	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
6 (2010)	Review Town of Middleburg's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Planning and Zoning	X		X		X										General funds	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No



XVI. Town of Occoquan

Derived from a Dogue Indian word meaning ‘at the end of the water’, Occoquan was divided into lots and streets were laid out in 1804 by Nathaniel Ellicott, James Campbell and Luke Wheeler. The town is located in northeastern Prince William County. The population of the town was 759 as of the 2000 Census and was estimated by the Census Bureau to be 834 in 2009. Based on the 2005-2009 American Community Survey, the town population was comprised of 76.7% white, 14% black or African American, 4.5% Native American, 1.2% from other races, and 3.6% bi-racial. Hispanic or Latino, of any race, represents 6.6% of the total population.



Occoquan has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 39 inches of rain and 16 or more inches of snow fall in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Occoquan is also subjected to tidal and storm surge flooding, due to the town’s location at the Fall Line on the Occoquan River, a tributary to the Potomac River. As sea levels rise, permanent inundation of low lying areas along and near the river shoreline is also a concern. Occoquan is also susceptible to other natural hazards and risks, such as storm damage and winter weather, as evidenced during the 2009 – 2010 winter and summer seasons.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Occoquan, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA’s NCDC⁵³. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence
- Vulnerability of population in the hazard area
- Historical impact, in terms of human lives and property and crop damage

The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, Winter Weather, and Drought hazards were ranked as ‘High’ for Occoquan. See Table 7.74 for a summary of hazard rankings.



Table 7.74: Hazard Ranking for Town of Occoquan									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	High	Med	Med-Low	Med	Med-Low

Annualized loss statistics for Prince William County based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.75.

Table 7.75: NCDC Annualized Loss by Hazard for Prince William County						
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)						
	Drought	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss (for all hazards)
<i>Years of Record</i>	17	17	21	59	17	
Prince William County	\$114,402	\$155,044	\$795,511	\$117,080	\$60,502	\$1,242,539

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Occoquan based on HAZUS^{MH} runs for flood, hurricane and earthquake are found in Tables 7.76, 7.77 and 7.78 below.

Table 7.76: HAZUS ^{MH} - Annualized Loss Due to Flood for Town of Occoquan								
Jurisdiction	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Total
Town of Occoquan	\$409,000	\$372,000	\$7,000	\$0	\$0	\$0	\$1,000	\$789,000

Table 7.77: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Town of Occoquan								
Jurisdiction	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Total
Town of Occoquan	\$898	\$84	\$1	\$57	\$6	\$29	\$6	\$1,080

Table 7.78: HAZUS ^{MH} - Annualized Loss Due to Earthquake for Town of Occoquan	
Jurisdiction	Annualized Loss
Town of Occoquan	\$635



As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects due to flooding is high, due to Occoquan's location. Earthquakes occasionally occur in the region; that was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland, shook the area.

A. Town of Occoquan Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Implement the relay dam sirens systems in the event of a dam failure.	Town Manager	X		X		X										USACE, FEMA Unified Hazard Mitigation Assistance funding.	December 2011	Secure funding and develop implementation plan by February 2011	High	No
2 (2010)	Initiate a public outreach campaign to inform residents of local hazards, to include dam failure and the new dam failure sirens.	Town Manager	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FEMA Unified Hazard Mitigation Assistance funding, US Army Corp of Engineers funding	December 2012	Develop outreach plan and identify dissemination methods by July 2012.	High	No
3 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Town Manager	X		X		X					X					FEMA Unified Hazard Mitigation Assistance funding.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No
4 (2010)	Review locality's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Town Manager	X		X		X										N/A, town manager evaluation.	Ongoing	Establish a schedule of review by June 2011.	Medium	No



5 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Town Manager	X		X		X				X					FEMA Unified Hazard Mitigation Assistance funding.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No
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XVII. Town of Purcellville

First settled in 1764, the village became known as Purcellville on July 9, 1852, and was incorporated in 1908. Many present structures in the town reflect the Victorian architecture of the turn of the century. Located in the western portion of Loudoun County, the town has a total area of 2.6 square miles. Wine production is a thriving industry in this area, with approximately 30 wineries in the region. The Blue Ridge Mountains are just to the west and in good weather are usually visible from town. Recreation includes the WO&D bike trail, the western portion of which ends here.



The population of the town was 3,584 as of the 2000 Census and was estimated by the Census Bureau to be 5,309 in 2009. The population density in 2000 was 1,512 persons per square mile. There were 1,292 housing units at an average density of 545 per square miles. Based on the 2005-2009 American Community Survey, the town population was comprised of 88% white, 3.8% black or African American, 2.4% Asian, 0.3% from other races, and 5.6% bi-racial. Hispanics or Latinos of any race were 5.8% of the total population.

Purcellville has a moderate climate. The average annual temperature is approximately 58 degrees. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 43 inches with over 20 inches of snow falling in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Purcellville, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA's NCDC⁵⁴. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of 'Low'; 'Medium-Low'; 'Medium'; 'Medium-High'; or 'High'. Based on this methodology, Flood, Wind, Tornado, Winter Weather, and Drought hazards were ranked as 'High' for Purcellville. See Table 7.79 for a summary of hazard rankings.



Table 7.79: Hazard Ranking for Purcellville								
Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
High	High	High	High	High	Med	Med-High	Med-Low	Med-Low

Annualized loss statistics for Purcellville based on NCDC historical data as the result of Flood, High Wind, Tornado, and Winter Storm are summarized in Table 7.80.

Table 7.80: NCDC Annualized Loss by Hazard for Loudoun County						
Annualized Loss as Determine through NCDC Data						
<i>(based on property and crop damages and number of years of record)</i>						
	Drought	Flood	High Wind	Tornado	Winter Storm	Total Annualized Losses (All Hazards)
<i>Years of Record</i>	17	17	21	59	17	
Loudoun County	\$351,549	\$216,429	\$176,618	\$119,785	\$31,982	\$896,364

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses. Much of the NCDC data is gathered from damage reports and insurance records.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Purcellville based on HAZUS^{MH} runs for hurricane and earthquake are found in Tables 7.81 and 7.82.

Table 7.81: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Purcellville								
Jurisdiction	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Total
Town of Purcellville	\$730	\$41	\$1	\$29	\$3	\$10	\$4	\$818

Table 7.82: HAZUS ^{MH} - Annualized Loss Due to Earthquake for Purcellville	
Jurisdiction	Annualized Loss
Town of Purcellville	\$911

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects due to hurricanes and earthquakes is generally low at less than \$1,000. Although



somewhat rare, earthquakes occasionally occur in the region. That was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland, shook the area.

A. Town of Purcellville Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completi on Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
4 (2006)	Assess the roadway structure at various intersections throughout the Town of Purcellville to avoid repeated flooding.	Public Works	X		X		X										Hazard Mitigation Assistance grant funding, County funding	December 2015	Identify funding sources by January 2012	High	No
1 (2010)	Continue to identify and employ a broad range of warning systems throughout the Town of Purcellville.	Police Department	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UASI funding, DHS grants, town/county funding	December 2015	Identify one new warning system to utilize by December 2012.	High	No
2 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.	Planning and Zoning	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
3 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Planning and Zoning	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completi on Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
4 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Planning and Zoning	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
5 (2010)	Review Town of Purcellville's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Planning and Zoning	X		X		X										General funds	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No



XVIII. Town of Quantico

Quantico is located on the Potomac River in Prince William County and surrounded by Marine Corps Base Quantico. The 2000 census estimate for the town was 561 and was estimated by the Census Bureau to be 607 in 2009. Based on the 2005-2009 American Community Survey, the town population was comprised of 63.8% white, 16.1% black or African American, 1.3% Native American, 6.3% Asian, 2.9% from other races, and 9.5% bi-racial. Hispanics or Latinos, of any race, represent 8.4% of the total population.

Quantico has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 41 inches of rain and 16 or more inches of snow fall in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

The town is also subjected to tidal and storm surge flooding, due to its location on the Potomac River. As sea levels rise, permanent inundation of low lying areas along and near the river shoreline is also a concern. Quantico is also susceptible to other natural hazards and risks, such as storm damage and winter weather, as evidenced during the 2009 – 2010 winter and summer seasons.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Quantico, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA’s NCDC⁵⁵. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of ‘Low’; ‘Medium-Low’; ‘Medium’; ‘Medium-High’; or ‘High’. Based on this methodology, Flood, Wind, Tornado, Winter Weather, and Drought hazards were ranked as ‘High’ for Quantico. See Table 7.83 for a summary of hazard rankings.

Table 7.83: Hazard Ranking for Town of Quantico									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	High	Med	Med-Low	Med	Med-Low



Annualized loss statistics for Prince William County based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.84.

Table 7.84: NCDC Annualized Loss by Hazard for Prince William County						
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)						
	Drought	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss (for all hazards)
<i>Years of Record</i>	17	17	21	59	17	
Prince William County	\$114,402	\$155,044	\$795,511	\$117,080	\$60,502	\$1,242,539

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Quantico based on HAZUS^{MH} runs for flood, hurricane, and earthquake are found in Tables 7.85, 7.86, and 7.87 below.

Table 7.85: HAZUS^{MH} - Annualized Loss Due to Flood for Town of Quantico								
Jurisdiction	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Total
Town of Quantico	\$16,000	\$17,000	\$0	\$0	\$0	\$0	\$0	\$33,000

Table 7.86: HAZUS^{MH} - Annualized Loss Due to Hurricane for Town of Quantico								
Jurisdiction	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Total
Town of Quantico	\$2,050	\$370	\$4	\$211	\$38	\$151	\$40	\$2,864

Table 7.87: HAZUS^{MH} - Annualized Loss Due to Earthquake for Town of Quantico	
Jurisdiction	Annualized Loss
Town of Quantico	\$1,032

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects due to flooding is high, due to Quantico’s location. Earthquakes occasionally occur in the region; that was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland, shook the area.

A. Town of Quantico Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Assess the roadway structure at various intersections throughout the Town of Quantico to avoid repeated flooding.	Office of the Mayor	X		X		X										Hazard Mitigation Assistance grant funding, County funding	December 2015	Identify funding sources by January 2012	High	No
2 (2010)	Continue to identify and employ a broad range of warning systems throughout the Town of Quantico.	Office of the Mayor	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UASI funding, DHS grants, town/county funding	December 2015	Identify one new warning system to utilize by December 2012.	High	No
3 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.	Office of the Mayor	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
4 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Office of the Mayor	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
5 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Office of the Mayor	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
6 (2010)	Review Town of Quantico's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Office of the Mayor	X		X		X										General funds	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No



XIX. Town of Round Hill

Named after the 910 foot hill located just southwest of the town center, and part of the foothills of the Blue Ridge Mountains, Round Hill was incorporated in 1900. Round Hill was used during the American Civil War as a signals post by both the Confederate and Union troops.

The Town is located at the crossroads of Virginia routes 7 and 719, approximately 45 miles northwest of Washington, DC. The town was the terminus of the Washington and Old Dominion Railroad, formerly the Washington and Ohio line. It is located 7 miles from the Shenandoah River, 15 miles from Harpers Ferry and four miles from the Appalachian Trail.



The population of the Round Hill was 500 as of the 2000 Census and was estimated by the Census Bureau to be 759 in 2009. It is part of Loudoun County. Round Hill covers 0.2 square miles of land. Based on the 2005-2009 American Community Survey, the town population was comprised of 99% white, 0.2% Asian, and 0.8% bi-racial.

Round Hill has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 38 inches of rain and 20 inches of snow fall in any given year, with May being the wettest month on average. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

Round Hill is subject to high wind events and extreme winter weather. Winter storms pose significant threats, as evidenced during the 2009 – 2010 winter season.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including Round Hill, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA's NCDC⁵⁶. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of 'Low'; 'Medium-Low'; 'Medium'; 'Medium-High'; or 'High'. Based on this methodology, Flood, Wind, Tornado, Winter Weather, and Drought hazards were ranked as 'High' for Round Hill. See Table 7.88 for a summary of hazard rankings.



Table 7.88: Hazard Ranking for Round Hill									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	High	Med	Med-High	Med-Low	Med-Low

Annualized loss statistics for Loudoun County based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.89.

Table 7.89: NCDC Annualized Loss by Loudoun County						
Annualized Loss as Determine through NCDC Data						
<i>(based on property and crop damages and number of years of record)</i>						
	Drought	Flood	High Wind	Tornado	Winter Storm	Total Annualized Losses (All Hazards)
Years of Record	17	17	21	59	17	
Loudoun County	\$351,549	\$216,429	\$176,618	\$119,785	\$31,982	\$896,364

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses. Much of the NCDC data is gathered from damage reports and insurance records.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for Round Hill based on HAZUS^{MH} runs for hurricane and earthquake are found in Tables 7.90 and 7.91 below.

Table 7.90: HAZUS ^{MH} - Annualized Loss Due to Hurricane for Round Hill								
Jurisdiction	Building	Contents	Inventory	Relocation	Income	Rental	Wage	Total
Town of Round Hill	\$44	\$2	\$0	\$2	\$0	\$1	\$0	\$48

Table 7.91: HAZUS ^{MH} - Annualized Loss Due to Earthquake for Round Hill	
Jurisdiction	Annualized Loss
Town of Round Hill	\$53

As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects is relatively low at \$49 for hurricane wind and \$53 for earthquake. Although



somewhat rare, earthquakes occasionally occur in the region. That was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland, shook the area.

A. Town of Round Hill Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Identify the Town's Critical Infrastructure and develop a GIS layer	Loudoun County Office of Emergency Management/Town of Round Hill Planning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Local funding, DHS funding, Hazard Mitigation Grant Programs	December 2012	Secure funding	Critical	No
2 (2010)	Implement drainage improvements in low-lying roadways.	Virginia Department of Transportation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	DHS funding, Hazard Mitigation Grant Programs	December 2014	Secure funding	Critical	No
3 (2010)	Provide back-up power for critical facilities.	Town of Round Hill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Local funding, DHS funding, Hazard Mitigation Grant Programs	December 2014	Secure funding	Critical	No
4 (2010)	Establish and test emergency notification procedures and protocols for Town personnel.	Town of Round Hill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Local funding	December 2012	Allocate funding	Critical	No
5 (2010)	Develop and test a Continuity of Operations Plan (COOP).	Town of Round Hill / Loudoun County Office of Emergency Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Local funding, DHS funding, Hazard Mitigation Grant Programs	December 2014	Secure funding	Critical	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
6 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.	Planning Commission	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
7 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Planning Commission	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No
8 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Planning Commission	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
9 (2010)	Review Town of Round Hill's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Planning Commission	X		X		X										General funds	Ongoing	review. Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No



XX. Town of Vienna

Originally called Ayr Hill, the Fairfax County village agreed in the 1850s to change its name to Vienna at the request of William Hendrick, a medical doctor who grew up in Vienna, New York. Vienna was incorporated into a town in 1890. The population of the town was 14,453 as of the 2000 Census and was estimated by the Census Bureau to be 15,215 in 2009. Based on the 2005-2009 American Community Survey, the town population was comprised of 76.5% white, 6% black or African American, 0.2% Native American, 11% Asian, 4.5% from other races, and 1.8% bi-racial. Hispanics or Latinos, of any race, represent 10.7% of the total population.



The Town of Vienna has a moderate climate. Temperatures generally range from lows in the mid-20s in January to highs in the upper-80s and lower-90s during the month of July. Annual precipitation averages are approximately 45 inches of rain and 15 or more inches of snow fall in any given year. Recent history proves that weather events well outside of these averages can and do occur. Climate change is expected to continue the trend of the past 40 to 50 years of an increased frequency of extreme weather events.

The town's location on the eastern edge of the Virginia piedmont make it susceptible to other natural hazards and risks, such as storm damage and winter weather, as evidenced during the 2009 – 2010 winter season.

The Town of Vienna's situation in the Washington metropolitan area and its ease of access by car and public transportation have attracted an increasingly-varied residential and commercial development. Fairfax County's central business district, Tyson's Corner, is just outside of the town's corporate limits. It is the 12th largest central business district in the United States.

To a large extent, historical records are used to identify the level of risk within the Northern Virginia region, including the Town of Vienna, with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, data on historical weather-related events is based on information made available through the Storm Event Database by NOAA's NCDC⁵⁷. Hazards were ranked using a semi-quantitative scoring system that involved grouping the data values (normalized to account for inflation) based on statistical methods. This method prioritizes hazard risk based on a blend of quantitative factors extracted from NCDC and other available data sources. The parameters considered include:

- Historical occurrence;
- Vulnerability of population in the hazard area; and
- Historical impact, in terms of human lives and property and crop damage.

The hazard scores were assigned a category of 'Low'; 'Medium-Low'; 'Medium'; 'Medium-High'; or 'High'. Based on this methodology, Flood, Wind, Tornado, and Winter Weather hazards were ranked as 'High' for the Town of Vienna. See Table 7.92 for a summary of hazard rankings.



Table 7.92: Hazard Ranking for the Town of Vienna									
Hazard	Flood	Wind	Tornado	Winter Weather	Drought	Earthquake	Landslide	Wildfire	Karst
Ranking	High	High	High	High	Med-High	Med	Med-Low	Med	Med-Low

Annualized loss statistics for Fairfax County based on NCDC historical data as the result of Flood, High Wind, Tornado and Winter Storm are summarized in Table 7.93. The NCDC only reports losses for hazards at the city and county level.

Table 7.93: NCDC Annualized Loss by Hazard for Fairfax County					
Annualized Loss as determine through NCDC data (based on property and crop damages and number of years of record)					
	Flood	High Wind	Tornado	Winter Storm	Total Annualized Loss
<i>Years of Record</i>	17	21	59	17	
Fairfax County	\$801,903	\$612,562	\$2,265,041	\$60,537	\$3,830,698

It should be noted that while the NCDC storm events data is the most comprehensive database available for which to compare most natural hazards, its considerable limitations include spotty property and crop damage data that are considered to significantly under-estimate actual losses.

FEMA’s HAZUS^{MH} model provides another method for estimating annualized loss that uses science and engineering principals and building stock values along with historical hazard occurrences to analyze potential damage and economic loss. Annualized loss statistics for the Town of Vienna based on HAZUS^{MH} runs for flood, hurricane and earthquake are found in Tables 7.94, 7.95 and 7.96 below.

Table 7.94: HAZUS ^{MH} - Annualized Loss Due to Flood for the Town of Vienna								
Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
Town of Vienna	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Table 7.95: HAZUS ^{MH} - Annualized Loss Due to Hurricane for the Town of Vienna								
Jurisdiction	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Income Loss	Rental Loss	Wage Loss	Total Annualized Loss
Town of Vienna	\$36,154	\$3,979	\$43	\$2,263	\$403	\$791	\$460	\$44,093

Table 7.96: HAZUS ^{MH} - Annualized Loss Due to Earthquake for the Town of Vienna	
Jurisdiction	Annualized Loss
Town of Vienna	\$29,422



As seen in the HAZUS^{MH} analysis, the potential annual loss to property, contents, inventory and related effects due to hurricanes is significant for the town. Earthquakes occasionally occur in the region; that was the case July 16, 2010, when a 3.6 magnitude quake centered near Gaithersburg, Maryland, shook the area.

A. Town of Vienna Mitigation Actions and Action Plan



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
1 (2010)	Assess the roadway structure at various intersections throughout the Town of Vienna to avoid repeated flooding.	Town of Vienna Public Works	X		X		X										Hazard Mitigation Assistance grant funding, County funding	December 2015	Identify funding sources by January 2012	High	No
2 (2010)	Continue to identify and employ a broad range of warning systems throughout the Town of Vienna.	Town of Vienna Police Department	X	X	X	X	X	X	X	X	X	X	X	X	X	X	UASI funding, DHS grants, town/county funding	December 2015	Identify one new warning system to utilize by December 2012.	High	No
3 (2010)	Conduct annual outreach to each FEMA-listed repetitive loss and severe repetitive loss property owner, providing information on mitigation programs (grant assistance, mitigation measures, flood insurance information) that can assist them in reducing their flood risk.	Town of Vienna Police Department	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Develop outreach materials, or identify appropriate outreach materials for dissemination by June 2011.	Medium	No
4 (2010)	Support mitigation of priority flood-prone structures through promotion of acquisition/ demolition, elevation, flood proofing, minor localized flood control projects, mitigation reconstruction and where feasible using FEMA HMA programs where appropriate.	Town of Vienna Police Department	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Identify all priority flood-prone structures by December 2011.	Medium	No



#	Agency/Department: Mitigation Action	Lead Agency Department Organization	Flood	Winter Weather	Thunderstorm	Tornado	Hurricane	Drought	Wildfire	Earthquake	Extreme Temps	Dam Failure	Erosion	Landslides	Karst	Human-Caused	Funding Source	Target Completion Date	Interim Measure of Success	Priority	Keep Action Redacted (Yes/No)
5 (2010)	Promote structural mitigation to assure redundancy of critical facilities, to include but not limited to roof structure improvement, to meet or exceed building code standards, upgrade of electrical panels to accept generators, etc.	Town of Vienna Police Department	X		X		X										FEMA Unified Hazard Mitigation Assistance funding for qualified structures.	Ongoing	Query local government building services staffs as to effectiveness of provided information regarding the structural review.	Medium	No
6 (2010)	Review Town of Vienna's compliance with the National Flood Insurance Program with an annual review of the Floodplain Ordinances and any newly permitted activities in the 100-year floodplain.	Town of Vienna Police Department	X		X		X										General funds	Ongoing	Establish a schedule of review and review committee (if necessary) by June 2011.	Medium	No



Chapter 8: Plan Maintenance

This section discusses how the mitigation strategies will be implemented by the Northern Virginia jurisdictions and how the overall Plan will be evaluated and enhanced over time. These aspects were reviewed and updated by the MAC for the 2010 update. This section also discusses how the public will continue to be involved in the hazard mitigation planning process. It consists of the following three subsections:

- Implementation;
- Monitoring, Evaluation and Enhancement; and
- Continued Public Involvement.

I. Implementation

Each jurisdiction participating in the Northern Virginia Hazard Mitigation Plan is responsible for implementing specific mitigation actions as prescribed in their locally adopted Mitigation Action Plan. In each Mitigation Action Plan, every proposed action is assigned to a specific local department or agency in order to assign responsibility and accountability and increase the likelihood of subsequent implementation. This approach enables individual jurisdictions to update their unique Mitigation Action Plan as needed without altering the broader focus of the Regional Plan. The separate adoption of locally-specific actions also ensures that each jurisdiction is not held responsible for monitoring and implementing the actions of other jurisdictions involved in the planning process.

In addition to the assignment of a local lead department or agency, the completion date and interim measure of success date have been assigned in order to assess whether actions are being implemented in a timely fashion. The Northern Virginia jurisdictions will seek outside funding sources to implement mitigation projects in both the pre-disaster and post-disaster environments. When applicable, potential funding sources have been identified and targeted for the proposed actions listed in the Mitigation Action Plans.

It will be the responsibility of each participating jurisdiction to determine additional implementation procedures beyond those listed within their Mitigation Action Plan. This includes integrating the requirements of the Northern Virginia Hazard Mitigation Plan into other local planning documents, processes, or mechanisms, such as comprehensive or capital improvement plans, when appropriate⁵⁸. The members of the Northern Virginia MAC will remain charged with ensuring that the goals and strategies of new and updated local planning documents for their jurisdictions or agencies are consistent with the goals and actions of the Hazard Mitigation Plan, and will not contribute to increased hazard vulnerability in their particular jurisdictions or the region as a whole.



Opportunities to integrate the requirements of this Plan into other local planning mechanisms shall continue to be identified through future meetings of the Northern Virginia MAC and through the five-year review process described herein. Although it is recognized that there are many possible benefits to integrating components of this Plan into other local planning mechanisms, the development and maintenance of this stand-alone Hazard Mitigation Plan is deemed by the Northern Virginia MAC to be the most effective and appropriate method to implement local hazard mitigation actions at this time. As such, the primary means for integrating mitigation strategies into other local planning mechanisms will be through the revision, update, and implementation of each jurisdiction's individual Mitigation Action Plan specific planning and administrative tasks (e.g., plan amendments, ordinance revisions, capital improvement projects, etc.).

The MAC will continue to coordinate with local jurisdictions in creating processes by which the requirements of this Plan will be incorporated into other local plans. During the planning process for new and updated local planning documents, such as a comprehensive plan, capital improvements plan, or emergency management plan, the MAC will provide a copy of the Plan to the appropriate parties. The MAC will continue to recommend that all goals and strategies of new and updated local planning documents be consistent with the Regional Plan and will not contribute to increased hazards in the affected jurisdiction(s).

II. Monitoring, Evaluation, and Enhancement

Periodic revisions and updates of the Northern Virginia Hazard Mitigation Plan are required to ensure that the goals of the plan are kept current, taking into account potential changes in hazard vulnerability and mitigation priorities. In addition, revisions may be necessary to ensure that the Plan is in full compliance with applicable Federal and State regulations. Periodic evaluation of the Plan will also ensure that specific mitigation actions are being reviewed and carried out according to each participating jurisdiction's individual Mitigation Action Plan.

The Northern Virginia MAC will continue to meet annually and following any disaster events warranting a reexamination of the mitigation actions being implemented or proposed by the participating jurisdictions. This will ensure that the Plan is continuously updated to reflect changing conditions and needs within the region. Each participating jurisdiction will be encouraged by the MAC to complete yearly reviews on the progress of their respective Mitigation Action Plan. If determined appropriate or as requested, an annual report on the Plan will be developed by the MAC and submitted to the local governing bodies of participating jurisdictions in order to report progress on the actions identified in the Plan and to provide information on the latest legislative requirements and/or changes to those requirements.

If any participating jurisdiction no longer wishes to actively participate in the development and maintenance of the plan, they must notify the MAC in writing.

A. Five-Year Plan Review

The plan will be reviewed by the MAC every five years to determine whether there have been any significant changes in the region that may, in turn, necessitate changes in the types of mitigation actions proposed. New development in identified hazard areas, an increased exposure



to hazards, the increase or decrease in capability to address hazards, and changes to Federal or State legislation are examples of factors that may affect the necessary content of the Plan.

The plan review process provides regional and community officials with an opportunity to evaluate those actions that have been successful and to explore the possibility of documenting potential losses avoided due to the implementation of specific mitigation measures. The plan review also provides the opportunity to address mitigation actions that may not have been successfully implemented as assigned. The MAC will be responsible for reconvening the MAC and conducting the five-year review in coordination with the VDEM.

During the five-year plan review process, the following questions will be considered as criteria for assessing the effectiveness and appropriateness of the Plan:

- Do the regional goals address current and expected conditions?
- Has the nature or magnitude of risks changed?
- Are the current resources appropriate for implementing the Plan?
- Are there local implementation problems, such as technical, political, legal, or coordination issues with other agencies?
- Have the outcomes occurred as expected?
- Did the jurisdictions, agencies, and other partners participate in the plan implementation process as proposed?

Following the five-year review, any necessary revisions will be implemented according to the reporting procedures and plan amendment process outlined herein. Upon completion of the review and update/amendment process, the Northern Virginia Hazard Mitigation Plan will be submitted to the State Hazard Mitigation Officer for final review and approval in coordination with FEMA.

B. Disaster Declaration

Following a disaster declaration, the Northern Virginia MAC will reconvene and the Plan will be revised as necessary to reflect lessons learned, or to address specific circumstances arising from the event. It will be the responsibility of the NVRC to reconvene the MAC and to ensure the appropriate stakeholders are invited to participate in the plan revision and update process following declared disaster events.

C. Reporting Procedures

The results of the five-year review will be summarized by the MAC in a report that will include an evaluation of the effectiveness of the Plan and any required or recommended changes or amendments. The report will also include an evaluation of implementation progress for each of the proposed mitigation actions, identifying reasons for delays or obstacles to their completion along with recommended strategies to overcome them.

Any necessary revisions to the Regional Plan elements shall follow the plan amendment process outlined herein. For changes and updates to the individual Mitigation Action Plans, appropriate local designees will assign responsibility for completion of the task.



D. Plan Amendment Process

Local participating jurisdictions have the authority to approve/adopt changes to their own Mitigation Action Plans without approval from the MAC; however, the MAC should be advised of all changes as a courtesy and for consideration for changes or modifications to the regional Plan. The MAC will be responsible for verifying that the proposed change will not affect the jurisdiction's compliance with current State and Federal mitigation planning requirements. Changes to either the Regional Plan or local Mitigation Action Plans will necessitate the adoption of these changes by the appropriate governing body, and ultimately or upon request the updated Plan or plan component(s) will be submitted to VDEM.

The MAC and its participating jurisdictions will forward information on any proposed change(s) to all interested parties including, but not limited to, all affected county and municipal departments, residents and businesses. When a proposed amendment may directly affect particular private individuals or properties, each jurisdiction will follow existing local, State or Federal notification requirements which may include published public notices as well as direct mailings. Information on any proposed plan amendments will also be forwarded to VDEM. This information will be disseminated in order to seek input on the proposed amendment(s) for not less than a 45-day review and comment period.

At the end of the 45-day review and comment period, the proposed amendment(s) and all comments will be forwarded to the MAC for final consideration. The committee will review the proposed amendment along with the comments received from other parties, and if acceptable, the committee will submit a recommendation for the approval and adoption of changes to the Plan to each appropriate governing body within 60 days.

In determining whether to recommend approval or denial of a plan amendment request, the following factors will be considered by the MAC:

- There are errors, inaccuracies, or omissions made in the identification of issues or needs in the Plan;
- New issues or needs have been identified which are not adequately addressed in the Plan;
- There has been a change in information, data, or assumptions from those on which the Plan is based; and
- There has been a change in local capabilities to implement proposed hazard mitigation activities.

Upon receiving the recommendation from the Northern Virginia MAC and prior to adoption of the Plan, each local governing body will hold a public hearing. The governing body will review the recommendation from the committee (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, the governing body will take one of the following actions:

- Adopt the proposed amendments as presented;
- Adopt the proposed amendments with modifications;
- Refer the amendments request back to the MAC for further revision; or
- Defer the amendment request back to the MAC for further consideration and/or additional hearings.



III. Continued Public Involvement

Public participation is an integral component of the mitigation planning process and will continue to be essential as this Plan evolves over time. As described above, significant changes or amendments to the Plan may require a public hearing prior to any adoption procedures.

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

- Advertising meetings of the MAC in the local newspaper, public bulletin boards, and/or municipal or county office buildings;
- Designating willing and voluntary citizens and private sector representatives as official members of the MAC;
- Utilizing local media to update the public on any maintenance and/or periodic review activities taking place;
- Utilizing the MAC and municipal or county websites to advertise any maintenance and/or periodic review activities taking place; and
- Keeping copies of the Plan in public libraries and making it accessible via public Websites.



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- ² The Future of the Washington Area Economy: Alternative Forecast, Employment and Housing Implications. Center for Regional Analysis George Mason University. September 2009. <http://www.cra-gmu.org/forecastreports/10forecasts/2%20-%202030%20Alternatives%20and%20Implications%20Sept%202009.pdf>
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- ⁴ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.
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- ⁷ 2006 FEMA Mitigation BCA Toolkit. July 2006, Version 3.0
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- ¹⁰ FEMA Severe Repetitive Loss Guidance for Severe Repetitive Loss Properties <http://www.fema.gov/pdf/nfip/manual200610/20srl.pdf> 10/2006
- ¹¹ NFIP repetitive loss data is protected under the federal Privacy Act of 1974 (5 U.S.C. 552a) which prohibits personal identifiers (i.e., owner names, addresses, etc.) from being published in local mitigation plans.
- ¹² National Flood Insurance Program (www.fema.gov)
- ¹³ HAZUS-MH MR4 Flood User Manual
- ¹⁴ Currently hosted at: <http://hurricane.ncdc.noaa.gov/CDO/cdo>
- ¹⁵ *Global Climate Change Impacts in the United States*, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.
- ¹⁶ Changes in severe thunderstorm environment frequency during the 21st century caused by anthropogenically enhanced global radiative forcing; Robert J. Trapp*†, Noah S. Diffenbaugh*, Harold E. Brooks‡, Michael E. Baldwin*, Eric D. Robinson*, and Jeremy S. Pal; PNAS December 11, 2007, vol. 104, no. 50.
- ¹⁷ IPCC Special Report on Emissions Scenarios, 2000
- ¹⁸ Modeled Impact of Anthropogenic Warming on the Frequency of intense Atlantic Hurricanes, Morris A. Bender, Thomas R. Knutson, Robert E. Tuleya, Joseph J. Sirutis, Gabriel A. Vecchi, Stephen T. Garner, Isaac M. Held
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- ²⁰ Whole Building Design Guide (WBDG) Wind Safety of the Building Envelop by Tom Smith 5/26/2008
- ²¹ Gutowski, W.J., G.C. Hegerl, G.J. Holland, T.R. Knutson, L.O. Mearns, R.J. Stouffer, P.J. Webster, M.F. Wehner, and F.W. Zwiers, 2008: Causes of observed changes in extremes and projections of future changes. In: *Weather and Climate Extremes in a Changing Climate: Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands* [Karl, T.R., G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray (eds.)]. Synthesis and Assessment Product 3.3. U.S. Climate Change Science Program, Washington, DC, pp. 81-116.
- ²² Significant Earthquakes figure is from the 2010 Commonwealth of Virginia's Hazard Mitigation Plan. Earthquake Section 3.13, Figure 3.13-1.
- ²³ The Daily News Spot July 16, 2010 interview with Amy Vaughan, geophysicist USGS National Earthquake Information Center.
- ²⁴ Recent Earthquakes from NEIC Earthquake Bulletin: Magnitude 3.4-Potomac-Shenandoan Region. USGS July 16, 2010. <http://earthquake.usgs.gov/earthquakes/recenteqsww/Quakes/us2010yua6.php>
- ²⁵ Recent Earthquakes from NEIC Earthquake Bulletin: Magnitude 3.4-Potomac-Shenandoan Region. USGS July 16, 2010. <http://earthquake.usgs.gov/earthquakes/recenteqsww/Quakes/us2010yua6.php>
- ²⁶ 2500-year Return Period Peak Ground Acceleration (PGA) figure is from the 2010 Commonwealth of Virginia's Hazard Mitigation Plan. Earthquake Section 3.13, Figure 3.13-3.
- ²⁷ Telephone and Email correspondence with Dr. Martin Chapman. June 3, 2010.



²⁸ Smith, K., *Environmental Hazards, Assessing Risk and Reducing Disaster*, Third Edition, Rutledge Press, New York 1991

²⁹ USGS Fact Sheet 2004-3072

³⁰ The National Wildfire Coordinating Group (NWCG) is made up of the USDA Forest Service; four Department of the Interior agencies: Bureau of Land Management (BLM), National Park Service (NPS), Bureau of Indian Affairs (BIA), and the Fish and Wildlife Service (FWS); and State forestry agencies through the National Association of State Foresters. The purpose of NWCG is to coordinate programs of the participating wildfire management agencies so as to avoid wasteful duplication and to provide a means of constructively working together.

³¹ U.S. Fire Administration. *National Fire incident Reporting System (NFIRS), Version IV.1 Incident Codes*. Retrieved from www.usfa.fema.gov/nfirs/tools.

³² Tihansky, B, Ann. U.S Geological Survey, Tampa, Florida. Sinkholes, West-Central Florida: A link between surface water and ground water.

³³ Hubbard, D. A. "Sinkhole Distribution of the Valley and Ridge Province, Virginia." *Geotechnical and Environmental Applications of Karst Geology and Hydrology*, (April 2001): 33–36.

³⁴ Loudoun County Zoning Ordinance Section 4-1900 Limestone Overlay District. May 6, 2010.

³⁵ Commonwealth of Virginia Emergency Hazard Mitigation Plan, 2010.

³⁶ See *Protecting the Past from Natural Disasters*. 1989. Nelson, Carl. National Trust for Historic Preservation: Washington, D.C.

³⁷ The EMAP Standard is based on the [NFPA 1600](#) Standard on Disaster/Emergency Management and Business Continuity Programs, 2004 Edition.

³⁸ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

³⁹ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

⁴⁰ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

⁴¹ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

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⁴³ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

⁴⁴ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

⁴⁵ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

⁴⁶ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

⁴⁷ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

⁴⁸ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

⁴⁹ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

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⁵³ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

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⁵⁶ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

⁵⁷ NCDC's Storm Event database is available at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>.

⁵⁸ A listing of each jurisdiction's local planning documents (or those under development) is provided in Section 7: Capability Assessment.