EXHIBIT NO. 1

21

2-13-07

City of Alexandria, Virginia

MEMORANDUM

DATE: FEBRUARY 8, 2007

TO: THE HONORABLE MAYOR AND MEMBERS OF CITY COUNCIL

FROM: JAMES K. HARTMANN, CITY MANAGER

SUBJECT: NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

ISSUE: Resolution adopting the Northern Virginia Regional Mitigation Plan.

RECOMMENDATION: That City Council:

(1) Approve the attached resolution adopting the Northern Virginia Regional Mitigation Plan as amended; and

(2) Authorize the Mayor to execute all necessary documents that may be required.

BACKGROUND: The federal Disaster Mitigation Act of 2000 (DMA 2000), as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to be eligible to receive grant funds from the Hazard Mitigation Grant Program (HMGP) and the Pre-Disaster Mitigation Program (PDM). Lessons learned from Hurricane Katrina and other natural disasters highlight the importance of reducing the vulnerability of the City to a natural disaster.

The staff representatives from the jurisdictions in Northern Virginia met from March 5, 2004 to May 4, 2005, to develop a multi-jurisdictional Hazard Mitigation Plan, which includes a specific local Mitigation Action Plan for each jurisdiction.

In August of 2005, the plan was submitted to the Virginia Department of Emergency Management (VDEM) and then the Federal Emergency Management Agency (FEMA) for approval. The plan received final approval from FEMA on July 10, 2006, subject to the adoption of the plan by all of the local jurisdictions.

DISCUSSION: The plan identifies the top natural hazards for Northern Virginia as floods, winter storms, severe thunderstorms, tornadoes, hurricanes/tropical storms. These hazards threaten the safety of residents and have the potential to damage or destroy public and private property, disrupt the local economy and have a very negative impact on the Northern Virginia region. The focus of the plan is limited to natural hazards only.

Hazard mitigation includes taking structural measures, such as strengthening or protecting buildings and infrastructure, and non-structural measures such as the adoption of sound land use policies or the creation of public awareness programs. The City has been addressing many of these issues for a number of years, but the cost of some of the mitigation strategies is significant, and we will seek any federal or state funds that may be available to assist in the funding that is needed.

The plan identifies eight specific mitigation strategies for the City of Alexandria. These can be found in Section 9, Pages 31 - 33 of the plan and are as follows:

1. Revise the Flood Insurance Rate Map

2. Separate the combined sanitary and storm sewers.

3. Enact state law to allow the use of recreational lakes or dams for flood control.

4. Install backflow prevention valves on properties subject to sewer backups in the Commonwealth Interceptor and the Four Mile Run sewer service areas.

5. Acquire flood prone properties and create public open space.

6. Elevate structures that have a history of repetitive loss due to floods.

7. Purchase and distribute NOAA weather alert radios for all the 1,634 flood insurance policy holders in Alexandria.

8. Purchase and install mobile public address systems in all City fleet vehicles to enhance our warning capabilities.

City staff recommends amending strategy #4 in order to clarify the intent of that strategy. The amendment would specify that the City would seek funding on the behalf of private owners of properties subject to sewer backups. The amended strategy would be:

4. Install backflow prevention valves in City properties subject to sewer backups and request funding for backflow prevention valves on behalf of affected private properties within the City.

It should be noted that the City has in place a backflow prevention valve program that enables homeowners to get $500 in City reimbursement for the installation of these valves in homes in the areas noted above. The homeowner is responsible for the balance of the cost. Generally the installation of the backflow prevention costs between $1,500 and $2,000. So far about 16 to 20 homeowners have participated in this program which is handled by the Department of Transportation and Environmental Services.

Adoption of the Northern Virginia Regional Hazard Mitigation Plan will ensure compliance with DMA 2000 and allow the City to seek disaster mitigation grant funds. City departments continue to work together to address hazard mitigation issues and to assist Alexandria residents and businesses in developing an awareness of the hazards they face.

FISCAL IMPACT: The adoption of the plan does not obligate the City to fund the mitigation strategies. The City may seek funding for these projects through grant programs that may require matching funds. At this time there is no fiscal impact.

ATTACHMENTS:
Attachment 1. Resolution
Attachment 2. Northern Virginia Regional Hazard Mitigation Plan

STAFF:
Mark Penn, Emergency Management Coordinator
Gary Mesaris, Fire Chief
Richard J, Baier, Director Transportation and Environmental Services
Douglas McCobb, Deputy Director Transportation and Environmental Services

ATTACHMENT 1

RESOLUTION NO.

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to be eligible for funding under the Pre-Disaster and Hazard Mitigation Grant Programs; and

WHEREAS, the Virginia Department of Emergency Management (VDEM) awarded a grant to the Northern Virginia Regional Commission (NVRC) in 2004 to develop a comprehensive Regional Hazard Mitigation Plan for Northern Virginia; and

WHEREAS, NVRC has coordinated this planning in collaboration with the Northern Virginia Hazard Mitigation Planning Committee (which includes representatives from local planning and emergency management staffs as well as VDEM) and with professional assistance from the consulting firm Post, Buckley, Schuh & Jernigan; and

WHEREAS, the plan outlines actions designed to address and reduce the impact of a full range of natural hazards facing the region, ranging from hazards as floods, tornadoes, hurricanes, earthquakes, wildfires and drought; and,

WHEREAS, VDEM and the Federal Emergency Management Agency (FEMA) have approved the Northern Virginia Regional Hazard Mitigation Plan, pending approval by each local governing body.

NOW, THEREFORE BE IT RESOLVED BY THE ALEXANDRIA CITY COUNCIL that the Northern Virginia Regional Hazard Mitigation Plan dated March 2006, is hereby approved and adopted as amended for the City of Alexandria;

BE IT FURTHER RESOLVED that Alexandria City Council) calls on emergency management to work with NVRC and VDEM to assure continued compliance with the Disaster Mitigation Act of 2000 and such additional regulations and/or certifications that may be identified to guarantee local and regional preparedness for all potential hazards and disasters. The undersigned duly qualified and acting as City Clerk of the PUBLIC BODY certifies that the foregoing is a true and correct copy of a Resolution, adopted at a legally convened meeting of the City Council held on the 27th day of February 2007.

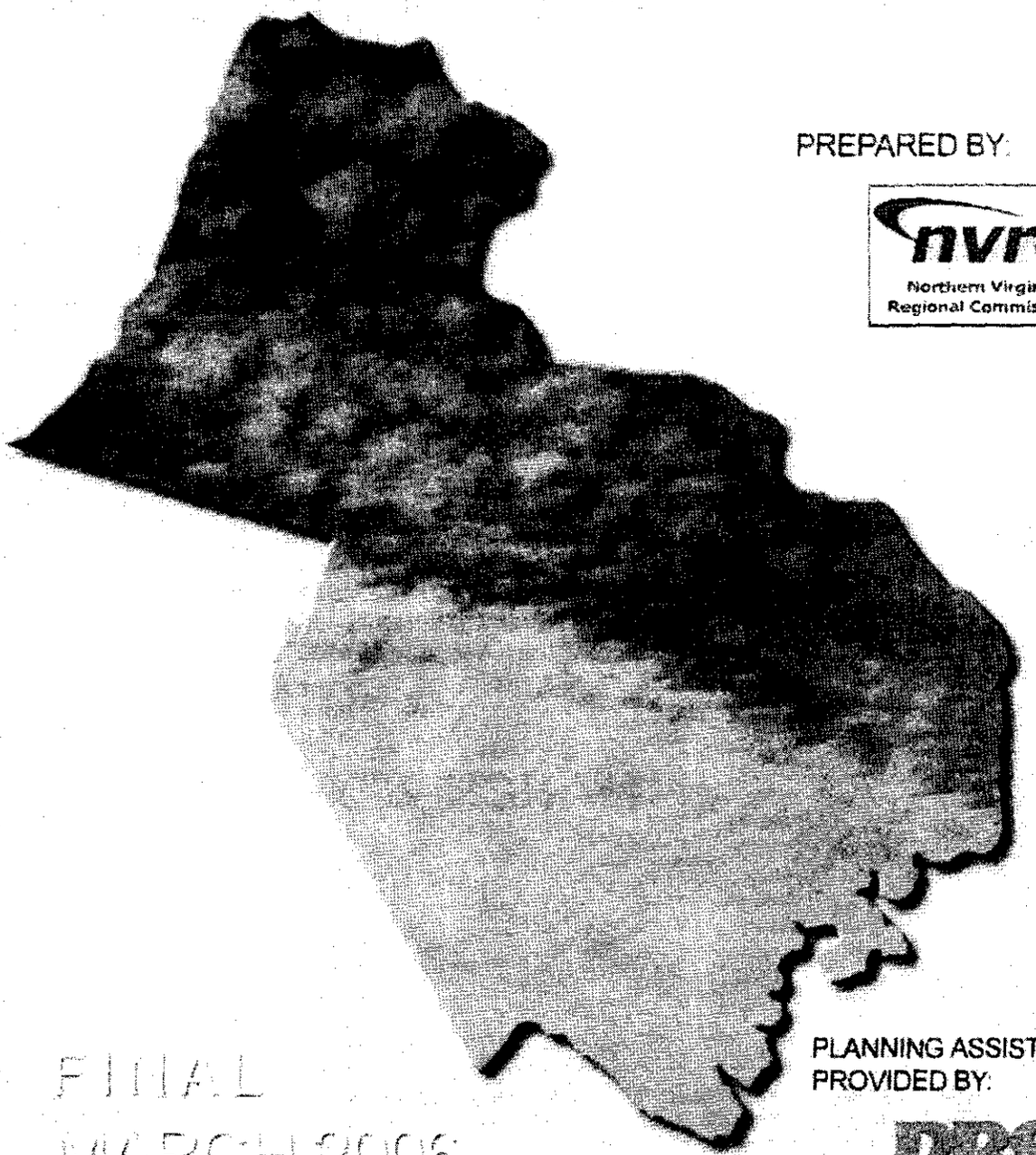
ADOPTED: _____
Date

_____
WILLIAM D. EUILLE MAYOR

ATTEST:

_____
JACQUELINE M. HENDERSON CITY CLERK

NORTHERN VIRGINIA
REGIONAL HAZARD MITIGATION PLAN



PREPARED BY:

nvrc
Northern Virginia Regional Commission

FINAL
MARCH 2006

PLANNING ASSISTANCE PROVIDED BY:

PBSJ

NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Prepared by:

Northern Virginia Regional Commission
7535 Little River Turnpike, Suite 100
Annandale, Virginia 22003

MARCH 2006

This Regional Hazard Mitigation Plan was prepared by the Northern Virginia Regional Commission (NVRC) in association with PBS&J, Inc. The NVRC is an independent public agency chartered in 1969 to plan for the physical, social and economic development of the region. The Commission serves in an advisory capacity to local, state, and federal governments and as an advocate for Northern Virginia and its 1.9 million residents. The Commission's policies and programs are established by a forty-two member Board of Commissioners comprised of elected officials and private citizens appointed by the governing bodies of Arlington, Fairfax, Loudoun and Prince William counties; the cities of Alexandria, Fairfax, Falls Church, Manassas and Manassas Park, and the towns of Dumfries, Herndon, Leesburg, Purcellville and Vienna.

TABLE OF CONTENTS

INTRODUCTION

This section provides a general introduction to the Northern Virginia Regional Hazard Mitigation Plan. It consists of the following five subsections:

- Background
- Purpose
- Scope
- Authority
- Summary of Plan Contents

Background

Natural hazards, such as floods, tornadoes and severe winter storms, are a part of the world around us. Their occurrence is natural and inevitable, and there is little we can do to control their force and intensity. In today's world we must also consider manmade hazards, such as technological accidents or deliberate acts of terrorism, as legitimate and significant threats to life, safety and property. That being said, the focus of this Hazard Mitigation Plan is limited to natural hazards only.

The Northern Virginia region is vulnerable to a wide range of natural hazards, including flooding, tornadoes, hurricanes and winter storms. These hazards threaten the safety of residents and have the potential to damage or destroy both public and private property, disrupt the local economy and impact the overall quality of life of individuals who live, work and play in the Northern Virginia region.

While we cannot eliminate natural hazards, there is much we can do to lessen their potential impact upon our community and our citizens. The effective reduction of a hazard's impact can decrease the likelihood that such events will result in a disaster. The concept and practice of reducing risks to people and property from known hazards is generally referred to as *hazard mitigation*.

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

Hazard mitigation techniques include both structural measures, such as strengthening or protecting buildings and infrastructure from the destructive forces of potential hazards, and non-structural measures, such as the adoption of sound land use policies or the creation of public awareness programs. Some of the most effective mitigation measures are implemented at the local government level where decisions on the regulation and control of development are made. A comprehensive mitigation strategy addresses hazard vulnerabilities that exist today and in the foreseeable future. Therefore it is essential that projected patterns of development are evaluated and considered in terms of how that growth will increase or decrease a community's overall hazard vulnerability. Land use is a particularly important topic in the Northern Virginia region, where many communities are facing increasing growth rates. Now is the time to effectively guide development away from identified hazard areas and environmentally sensitive locations, before unsound development patterns emerge and people and property are placed in harm's way.

One of the most effective tools a community can use to reduce hazard vulnerability is to develop, adopt, and update as needed, a local *hazard mitigation plan*. A hazard mitigation plan establishes the broad community vision and guiding principles for addressing hazard risk, including the development of specific mitigation actions designed to eliminate or reduce identified

vulnerabilities. The Northern Virginia Regional Hazard Mitigation Plan (hereinafter "Hazard Mitigation Plan" or "Plan") is a logical first step toward incorporating hazard mitigation principles and practices into the routine activities and functions of local government within the Northern Virginia region.

The mitigation actions noted in this Plan go beyond recommending structural solutions to reduce existing vulnerability. Local policies addressing community growth, incentives to protect natural resources, and public awareness and outreach campaigns are examples of other measures that can be used to reduce the future vulnerability of the Northern Virginia region to identified hazards. The Plan has been designed to be a living document, with implementation and evaluation procedures included to help achieve meaningful objectives and successful outcomes.

Disaster Mitigation Act of 2000

In an effort to reduce the Nation's mounting natural disaster losses, the U.S. Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) in order to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act. Section 322 of DMA 2000 emphasizes the need for state and local government entities to closely coordinate on mitigation planning activities, and makes the development of a hazard mitigation plan a specific eligibility requirement for any local government applying for federal mitigation grant funds. These funds include the Hazard Mitigation Grant Program (HMGP) and the newly-created Pre-Disaster Mitigation (PDM) program, both of which are administered by the Federal Emergency Management Agency (FEMA) under the Department of Homeland Security. Communities with an adopted and federally-approved hazard mitigation plan thereby become pre-positioned and more apt to receive available mitigation funds before and after the next disaster strikes.

The Plan has been prepared in coordination with FEMA Region III and the Virginia Division of Emergency Management to ensure that the Plan meets all applicable DMA 2000 and state requirements. A *Local Mitigation Plan Crosswalk*, found in Appendix C, provides a summary of federal and state minimum standards and notes the location where each requirement is met within the Plan.

Linking Hazard Mitigation and Sustainability

The Northern Virginia Regional Hazard Mitigation Plan is guided by three broad principles, including *sustainability*, *safe growth* and *mitigation actions* based on the findings of the risk and capability assessments. Sustainability, simply put, is taking actions today that allow for future generations to live in a community that is of the same quality or better than that experienced by the current population. Sustainability is a framework that is intended to guide the actions taken by elected officials, citizens and the business leaders to make the Northern Virginia region a place where people can enjoy a sound economy, safe communities, a healthy environment and plentiful recreational opportunities.

The adoption of hazard mitigation practices are viewed as complimentary to the goals of sustainability. Broadly speaking, by making communities less vulnerable, they become better places to live. For example, a specific action may include the relocation of flood-prone properties to an area outside of the identified floodplain. In turn, the land is allowed to revert back to open space in its natural state or may become part of a managed park or greenway system. By taking this action, several goals can be achieved:

- A reduction in the number of structures located in harm's way;
- The elimination of necessary emergency response, such as search and rescue activities, in that area following a flood;

- The creation of additional parkland that may include recreational amenities such as hiking trails, bicycle paths or canoe access points;
- The conversion of the floodplain back to its natural function; and
- A reduction in non-point source pollution.

The consideration of land use and safe growth practices are two other key elements of this Plan. The concept of safe growth will be used to describe this process. Safe growth may be described as simply reviewing all future land use decisions with the following types of questions in mind: Will this proposed use increase hazard vulnerability? If so, how could this practice be modified in such a way that a given activity accounts for identified hazards? Specific safe growth techniques may include, but are not limited to: cluster development, setback requirements, the identification and mapping of hazard zones and environmentally sensitive areas, and related smart growth activities.

Purpose

The purpose of the Northern Virginia Regional Hazard Mitigation Plan is to:

- Protect life, safety and property by reducing the potential for future damages and economic losses that result from **natural** hazards;
- Make communities safer places to live, work and play;
- Qualify for grant funding in both the pre-disaster and post-disaster environment;
- Speed recovery and redevelopment following future disaster events;
- Demonstrate a firm local commitment to hazard mitigation principles; and
- Comply with state and federal legislative requirements for local multi-jurisdictional hazard mitigation plans.

Scope

The greater focus of this Plan will fall upon on those hazards determined to be "high" or "moderate" risk as determined through a detailed hazard risk assessment conducted for the Northern Virginia region.[1] Other hazards that pose a low or negligible risk will continue to be evaluated during future updates to the Plan, but they may not be fully addressed until they are determined to be of high or moderate risk. This enables those counties, cities and towns participating in the development and maintenance of the Plan to prioritize mitigation actions based on those hazards which are understood to present the greatest risk to lives and property.

The geographic scope (i.e. the planning area) for the Plan includes the following four counties, five cities and five towns in the Northern Virginia region. It should be noted that independent cities within the Commonwealth of Virginia are politically separate from counties (and retain the same authority as counties), whereas incorporated towns are not.

[1] See Section 6: Vulnerability Assessment, for the comparative ranking of hazards and their determined risk classification.

Counties:

- Arlington County
- Fairfax County
- Loudoun County
- Prince William County

Cities:

- City of Alexandria
- City of Fairfax
- City of Falls Church
- City of Manassas
- City of Manassas Park

Towns:

- Town of Dumfries (Prince William County)
- Town of Herndon (Fairfax County)
- Town of Leesburg (Loudoun County)
- Town of Vienna (Fairfax County)
- Town of Purcellville (Loudoun County)

Authority

The Plan, developed in accordance with current state and federal rules and regulations governing local hazard mitigation plans, has been adopted by the four (4) counties and ten (10) participating municipalities in accordance with the authority and police powers granted to counties and municipalities under §15.2-2223 through §15.2-2231 of the Virginia State Code. Copies of local adoption resolutions are provided in Appendix A. The Plan shall be routinely monitored and revised to maintain compliance with the following provisions, rules and legislation:

- Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the Disaster Mitigation Act of 2000 (P.L. 106-390); and

- FEMA's Interim Final Rule published in the Federal Register on February 26, 2002, at 44 CFR Part 201.

Summary of Plan Contents

The remaining contents of this Plan are designed and organized to be as reader-friendly and functional as possible. While significant background information is included on the processes used and studies completed (e.g. risk assessment, capability assessment), this information is separated from the more meaningful planning outcomes or actions (e.g. mitigation strategy, mitigation action plans).

Section 2, ***Planning Process***, provides a complete narrative description of the process used to prepare the Plan. This includes the identification of who was involved, who participated on the planning team, and how the public and other stakeholders were involved. It also includes a detailed summary for each of the key meetings held along with any associated outcomes.

The ***Community Profile***, located in Section 3, describes the general makeup of the Northern Virginia region, including prevalent geographic, demographic and economic characteristics. In

addition, transportation, housing and land use patterns are discussed. This baseline information provides a snapshot of the regional planning area and thereby assists county and municipal officials recognize those social, environmental and economic factors that ultimately play a role in determining community vulnerability to natural hazards.

The ***Risk Assessment*** is presented in three separate sections: Section 4: ***Hazard Identification***; Section 5: ***Hazard Analysis***; and Section 6: ***Vulnerability Assessment***. Together, these sections serve to identify, analyze and assess the Northern Virginia region's overall risk to natural hazards. The risk assessment also attempts to define any hazard risks that may uniquely or exclusively affect the individual municipal jurisdictions.

The Risk Assessment builds on available historical data from past hazard occurrences, establishes detailed profiles for each hazard, and culminates in a hazard risk ranking based on conclusions about the frequency of occurrence, spatial extent and potential impact of each hazard. FEMA's HAZUS©MH loss estimation methodology was also used in evaluating known hazard risks by their relative long-term cost in expected damages. In essence, the information generated through the risk assessment serves a critical function as communities seek to determine the most appropriate mitigation actions to pursue and implement — enabling communities to prioritize and focus their efforts on those hazards of greatest concern and those structures or planning areas facing the greatest risk(s).

The ***Capability Assessment***, found in Section 7, provides a comprehensive examination of each participating jurisdiction's capacity to implement meaningful mitigation strategies and identifies existing opportunities to increase and enhance that capacity. Specific capabilities addressed in this section include planning and regulatory capability, staff and organizational (administrative) capability, technical capability, fiscal capability, and political capability. Information was obtained through the use of detailed survey questionnaires for local officials and an inventory and analysis of existing plans, ordinances and relevant documents. The purpose of this assessment is to identify any existing gaps, weaknesses or conflicts in programs or activities that may hinder mitigation efforts, and to identify those activities that should be built upon in establishing a successful and sustainable regional hazard mitigation program.

The *Community Profile*, *Risk Assessment*, and *Capability Assessment* collectively serve as a basis for determining the goals for the Hazard Mitigation Plan, each contributing to the development, adoption and implementation of a meaningful *Mitigation Strategy* that is based on accurate background information.

The ***Mitigation Strategy***, found in Section 8, consists of broad regional goal statements as well as specific mitigation actions for each local government jurisdiction participating in the planning process. The strategy provides the foundation for detailed ***Mitigation Action Plans***, found in Section 9, that link specific mitigation actions for each jurisdiction to locally-assigned implementation mechanisms and target completion dates. Together, these sections are designed to make the Plan both strategic (through the identification of long-term goals) but also functional through the identification of short-term and immediate actions that will guide day-to-day decision-making and project implementation.

In addition to the identification and prioritization of possible mitigation projects, emphasis is placed on the use of program and policy alternatives to help make the communities of the Northern Virginia region less vulnerable to the damaging forces of nature while improving the economic, social and environmental health of the community. The concept of multi-objective planning was emphasized throughout the planning process, particularly in identifying ways to link hazard mitigation policies and programs with complimentary community goals related to housing,

economic development, downtown revitalization, recreational opportunities, transportation improvements, environmental quality, land development, and public health and safety.

The ***Plan Maintenance Procedures***, found in Section 10, includes the measures that the Northern Virginia Regional Commission and participating jurisdictions will take to ensure the Plan's continuous long-term implementation. The procedures also include the manner in which the Plan will be regularly evaluated and updated to remain a current and meaningful planning document.

PLANNING PROCESS

This section of the Plan describes the mitigation planning process undertaken by the jurisdictions participating in the development of the Northern Virginia Regional Hazard Mitigation Plan. It consists of the following seven subsections:

- Overview of Hazard Mitigation Planning
- Preparing the Plan
- The Planning Team
- Community Meetings and Workshops
- Involving the Public
- Involving Stakeholders
- Multi-jurisdictional Participation

Overview of Hazard Mitigation Planning

Local hazard mitigation planning is the process of organizing community resources, identifying and assessing hazard risks, and determining how to best minimize or manage those risks. This process results in a hazard mitigation plan that identifies specific mitigation actions, each designed to achieve both short-term planning objectives and a long-term community vision. To ensure the functionality of each mitigation action, responsibility is assigned to a specific individual, department or agency along with a schedule for its implementation. Plan maintenance procedures are established for the routine monitoring of implementation progress, as well as the evaluation and enhancement of the mitigation plan itself. These plan maintenance procedures ensure that the plan remains a current, dynamic and effective planning document over time.

Mitigation planning offers many benefits, including:

- saving lives and property;
- saving money;
- speeding recovery following disasters;
- reducing future vulnerability through wise development and post-disaster recovery and reconstruction;
- expediting the receipt of predisaster and post-disaster grant funding; and
- demonstrating a firm commitment to improving community health and safety.

Typically, mitigation planning is described as having the potential to produce long-term and recurring benefits by breaking the repetitive cycle of disaster loss. A core assumption of hazard mitigation is that predisaster investments will significantly reduce the demand for post-disaster assistance by lessening the need for emergency response, repair, recovery and reconstruction. Furthermore, mitigation practices will enable local residents, businesses and industries to re-establish themselves in the wake of a disaster, getting the community economy back on track sooner and with less interruption.

The benefits of mitigation planning go beyond solely reducing hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, maintaining environmental health and enhancing recreational opportunities. Thus, it is vitally important that any local mitigation planning process be integrated with other concurrent local planning efforts, and any proposed

mitigation strategies must take into account other existing community goals or initiatives that will help complement or hinder their future implementation.

Preparing the Plan

44 CFR Requirement

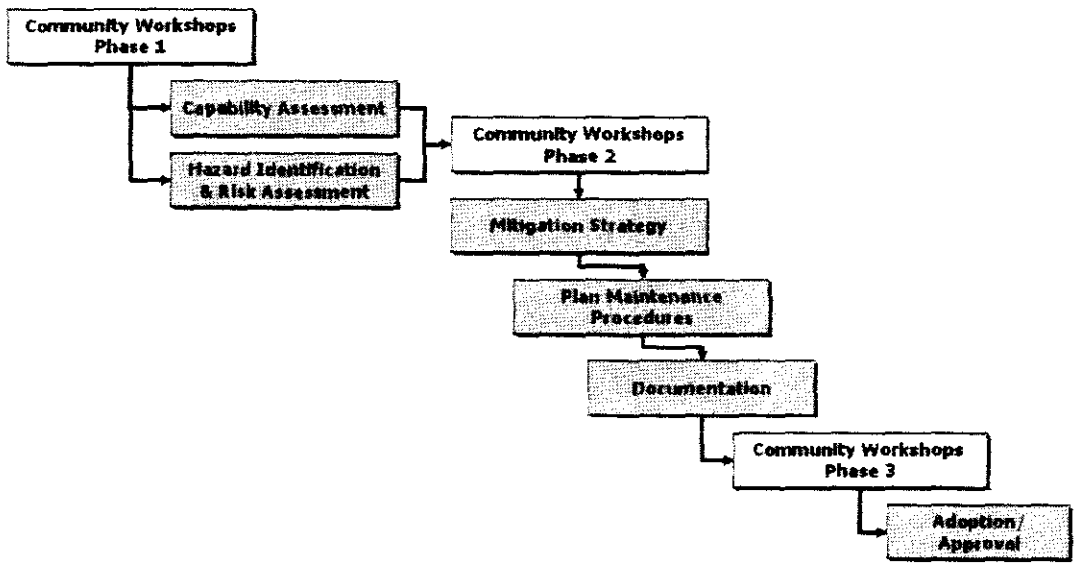
Part 201.6(c)(1): ***The plan shall include documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process and how the public was involved.***

The regional planning effort to develop and maintain the Plan has been lead and facilitated by the Northern Virginia Regional Commission (hereinafter "NVRC" or "Commission"). NVRC is an independent public agency serving in an advisory capacity to local, state, and federal governments and as an advocate for the Northern Virginia region. The Commission's policies and programs are established by a forty-two member Board of Commissioners comprised of elected officials and private citizens appointed by the governing bodies of those local jurisdictions listed above.

NVRC utilized the multi-jurisdictional planning process recommended by the Federal Emergency Management Agency (FEMA Publication Series 386) to develop this Plan. A *Local Mitigation Plan Crosswalk*, found in Appendix C, provides a detailed summary of FEMA's current minimum standards of acceptability for compliance with the Disaster Mitigation Act of 2000 and notes the location of where each requirement is met within the Plan. These standards are based upon FEMA's Interim Final Rule as published in the Federal Register on February 26, 2002, in Part 201 of the Code of Federal Regulations (CFR).

The planning process included nine (9) major steps that were completed over the course of approximately one year. Each of these planning steps (illustrated in **Figure 2.1**) resulted in critical work products and outcomes that collectively make up the Hazard Mitigation Plan. These elements have been included as separate sections of the Plan, and are further discussed in detail in Section 1: Introduction.

Figure 2.1
Northern Virginia Regional Hazard Mitigation Planning Process



The Planning Team

A community-based planning team made up of local government officials and key stakeholders helped guide the development of this Plan. Beginning in March 2004, NVRC engaged local officials throughout the region in local meetings and planning workshops to discuss and complete tasks associated with preparing the Plan. This working group coordinated together on all aspects of the plan development process and became formally recognized as the *Northern Virginia Hazard Mitigation Planning Committee.* In addition to regular meetings, committee members routinely communicated and were kept informed through a dedicated e-mail distribution group.

Additional participation and input from identified stakeholders and the general public was sought by NVRC during the planning process through phone calls and the distribution of e-mails, advertisements and public notices aimed at informing people on the status of the regional plan (public involvement is further discussed later in this section).

Table 2.1 lists the members of the Northern Virginia Hazard Mitigation Planning Committee who were responsible for participating in the development of the Plan. Committee members are listed in alphabetical order by their respective jurisdiction.

Table 2.1
Northern Virginia Hazard Mitigation Planning Committee

Name	Jurisdiction	Title / Agency
Mark Penn	City of Alexandria	Emergency Management
Jeff Stern	Arlington County	Office of Emergency Management
John C. Barkley	Town of Dumfries	Town Manager
Susan K. Moore	Town of Dumfries	Assistant to Town Manager
Robert Murray	City of Falls Church	Chief
Andrew Wilson	City of Fairfax	Assistant Chief, Fire Department
Michael Congleton	Fairfax County	Planning and Zoning
William Mackay	Fairfax County	Office of Emergency Management
Lt. Brad Anzengruber	Town of Herndon	Emergency Management
Henry Bibber	Town of Herndon	Planning Department
Nick Colonna	Town of Leesburg	Senior Planner
Robert Griffin	Loudoun County	Fire and Rescue
Kevin Johnson	Loudoun County	Fire and Rescue
Matt Partlow	Loudoun County	Fire and Rescue
Julie Pastor	Loudoun County	Planning Department
Rocco A. Christoff	City of Manassas	Emergency Coordinator / Police Dept
Richard Hill	City of Manassas	Hazmat Officer
Capt. Mark Matthews	City of Manassas Park	Captain
James Van Zee	NVRC	Director of Regional Planning
William Druham	Town of Purcellville	Mayor
Patrick M. Collins	Prince William County	Emergency Management
David B. Grover	Prince William County	Planning Department
Katrina L. Ziegenhorn	Town of Vienna	Planning Department

Community Meetings and Workshops

The preparation of the Plan required a series of meetings and workshops for facilitating discussion and initiating data collection efforts with local community officials. More importantly, the meetings and workshops prompted continuous input and feedback from local officials throughout the drafting stages of the Plan. Below is a summary of the key meetings and community workshops for the Northern Virginia Hazard Mitigation Planning Committee.[1] In many cases, additional meetings were held by the individual participating jurisdictions to accomplish planning tasks specific to their community, such as the approval of locally specific mitigation actions for inclusion in their Mitigation Action Plan.

March 5, 2004
Initial Meeting of the Northern Virginia Hazard Mitigation Planning Committee

Mark Gibbs, NVRC's Executive Director, opened the meeting explaining the number of emergency preparedness efforts underway throughout the region. James Van Zee, NVRC 's Director of Regional Planning Services and project manager, stated the purpose for a Northern Virginia Hazard Mitigation Plan under the Disaster Mitigation Act of 2000, which is to qualify Northern Virginia's localities for pre-disaster hazard mitigation project grants (should funds be made available) and for post-disaster hazard mitigation grants that would be in addition to the normal emergency response and recovery funding provided to the community after a major disaster declaration.

David Corzilius, with the Virginia Department of Emergency Management (VDEM), gave a program overview. His presentation included an introduction to mitigation planning and the steps necessary to prepare a regional hazard mitigation plan that is complain with the Disaster Mitigation Act of 2000, as well as additional state requirements to consider. He distributed several handouts, including a recommended mitigation plan outline and Virginia mitigation planning requirements.

Following Mr. Corzilius's presentation, Mr. Van Zee led the Committee in a discussion of several topics. The first issue presented to the Committee was whether or not manmade hazards should be included in this planning effort. Mr. Van Zee and Mr. Corzilius explained that under the Disaster Mitigation Act of 2000 and the VDEM grant to NVRC, manmade hazards are not required to be included. It was noted that other groups in the region are addressing manmade disasters. In fact many members of the Committee serve on these groups as well and manmade hazards might be identified in this process for future study. NVRC recommended that this effort concentrate on natural disasters and not include manmade hazards. The Committee agreed.

Linda Tenney, NVRC's Deputy Executive Director, and James Van Zee explained that a draft RFP was being prepared and welcomed recommendations of contractors.

Linda Tenney and David Corzilius addressed the requirements and typical approaches for the public participation and media in this process. Ms. Tenney explained that NVRC would prepare a public participation with input from groups like the Public Information Officers (PIO) committee and bring it back to the Hazard Mitigation Planning Committee.

Mr. Van Zee addressed the role of the Hazard Mitigation Planning Committee, which is to:

- Serve as advisors at key points in the process
- Serve as point of contact in collecting local data

[1] Copies of the agendas, sign-in sheets, minutes and handout materials for all meetings and workshops are available through the NVRC upon request.

- Review the hazard identification, risk assessment, and vulnerability & loss estimation findings and to provide comments/revisions.
- Assist NVRC and/or contractor in development of mitigation strategies
- Review draft & final plan
- Contribute & document hours to this project as local in-kind match

He noted that a final timetable will be developed with the contractor, but the project is projected to take one (1) year. State and FEMA guidance materials were distributed to a representative from each locality.

Finally, Mr. Corzilius explained that local "Mitigation Planning Workshops" are scheduled and encouraged all Planning Committee members to sign up, if they haven't already done so.

May 5, 2004
Initial Consultant Meeting with PBS&J

Following an open proposal process, NVRC selected and contracted with the consulting firm of PBS&J to assist in the development of the regional hazard mitigation plan. PBS&J is being supported by the subcontracting firms of Dewberry and URS. The initial project kickoff meeting was held between NVRC and PBS&J to discuss the contractual scope of work and expectations for both NVRC and PBS&J. In attendance were James Van Zee, NVRC's Director of Regional Planning and project manager, along with Dr. Gavin Smith, Program Manager and Darrin Punchard, Project Manager from PBS&J.

During the meeting, Mr. Van Zee summarized many of NVRC's on-going activities relating to the development of the regional hazard mitigation plan, including the establishment of an interagency committee for regional emergency preparedness. Subsequent discussions included how best to take advantage of these concurrent planning efforts, such as linking the regional public outreach and education initiatives soon to be under way. Discussions also included the potential and usefulness of any open public meetings to be held during the planning process, with perhaps one upon completion of the regional risk assessment and another upon completion of the draft plan. Mr. Van Zee indicated that this idea would be discussed with NVRC's PIO Committee, as well as the possible use of a public participation survey designed by PBS&J.

Dr. Smith and Mr. Punchard discussed the critical data collection efforts needed for the risk assessment and the capability assessment, and how the Northern Virginia Hazard Mitigation Planning Committee could be used to assist in the process. Several examples of data collection instruments were made available to NVRC, and it was determined that all communication and data collection between PBS&J and the local participating communities would go through NVRC. It was explained by Mr. Van Zee that there is a wealth of information available across the region, and that PBS&J should be as specific as possible in requesting the types of data needed to complete associated planning tasks.

Discussions between NVRC and PBS&J also focused on the overall project approach and the proposed timeline for its completion. It was agreed that the project will not likely be completed prior the November 1st deadline, but that the schedule would be reassessed upon the completion of the regional risk assessment study. If necessary, it was agreed that NVRC would submit an extension to the Virginia Department of Emergency Management, as required.

Finally, the roles and responsibilities of PBS&J, NVRC and its participating jurisdictions were assigned, and the next steps to take were discussed. Future meetings were described, including the structure for the next meeting with the Northern Virginia Hazard Mitigation Planning Committee and the importance of the subsequent mitigation strategy workshop.

June 25, 2004
Community Workshop – Phase One (Kickoff Meeting)
Northern Virginia Hazard Mitigation Planning Committee

The project kickoff meeting was held on June 25, 2004 with the staff of the Northern Virginia Regional Commission, staff members from project consultants PBS&J and Dewberry and the local officials of the participating counties and municipalities. The meeting included a formal presentation[2] by PBS&J on their overall project approach, with an emphasis on the steps necessary to meet the requirements of the Disaster Mitigation Act of 2000. The kickoff meeting also served to initiate the preliminary data collection efforts for the risk and capability assessment tasks associated with the development of the Plan.

Members of the NVRC Hazard Mitigation Planning Committee gathered early in the planning process to discuss necessary tasks and individual roles and responsibilities for preparing the regional plan.

First, a description of the hazard mitigation planning process was presented, explaining each step and the type of data that will be required to complete each associated task. Then, specific planning methods and data collection tools, such as the *Capability Assessment Survey*, were distributed and further described. Finally, the proposed project schedule was presented and the individual roles and responsibilities of each committee member were thoroughly explained and assigned. Specific roles for the parties involved in the process included the following major tasks:

Northern Virginia Regional Commission

- Project management
- Coordination
  - Interlocal agreements
  - Meetings and workshops
  - Data collection and exchange
- Communications
  - Group e-mail distribution
  - Website

PBS&J Project Team

- Technical assistance
  - Planning guidance
  - State and federal compliance
- Data collection & analysis
  - Risk assessment
  - Capability assessment
  - Report findings
- Facilitate Mitigation Strategy Workshop
- Plan Preparation

[2] Copies of all PowerPoint presentation slides are available through the NVRC upon request.

County and Municipal Governments

- Participation
  - Data collection (risk assessment and capability assessment)
  - Meetings
  - Mitigation strategy development
  - Public involvement
  - Plan review & feedback
- Plan Adoption
- On-going Coordination
  - Additional data needs (risk assessment, capability assessment, and public participation)
- Future meetings
  - Risk assessment and capability assessment findings
  - Mitigation strategy workshops
  - Draft plan presentations

Upon completion of the presentation by PBS&J, the committee members had the opportunity to ask questions, clarify uncertainties and express their concerns regarding the project. These were primarily related to the methodologies and data requirements for completing the risk and capability assessments, in addition to the types of mitigation actions each jurisdiction should consider for inclusion in their *Mitigation Action Plans*. Most committee members had attended the first meeting in March 2004, and were therefore fully prepared and anxious to get started with the process.

Prior to adjourning the meeting, PBS&J's data collection efforts were launched through the distribution and explanation of the *Capability Assessment Survey* to each member of the committee. Each committee member was assigned the task of going back to their respective agency or jurisdiction and meeting with appropriate officials to complete the survey questionnaire. The committee determined that all surveys should be completed and returned to NVRC by July 23, 2004. It was determined that PBS&J and NVRC would continue to coordinate with one another on collecting the data necessary to complete the hazard risk assessment, but would also follow up with each of the participating local jurisdictions individually to obtain any locally-specific and readily available data, including but not limited to historical hazard data and any relevant GIS data layers that could be incorporated into the study.

September 24, 2004
Community Workshop – Phase Two (Mitigation Strategy Workshop)
Northern Virginia Hazard Mitigation Planning Committee

The second community workshop was held on September 24, 2004 in the form of a five hour "Mitigation Strategy Workshop." The workshop began with a detailed presentation by PBS&J on the findings of the risk assessment and capability assessment. By providing county and municipal officials with a more thorough understanding of the hazard risks in their communities along with the varied levels of local capabilities available to address them, the stage became set for the next step in the process — the creation of mitigation planning goals and the identification of specific mitigation actions designed to reduce or eliminate future hazard impacts.

To summarize, the following general findings were presented and discussed during the workshop.[3]

Risk Assessment Findings:

- Since 1965, the Northern Virginia region has received ten presidential disaster declarations (not including emergency declarations) for a variety of events (hurricanes, severe winter storms, flooding and terrorism).
- Based on the completion of the hazard analysis, the region is at risk to floods, hurricanes and tropical storms, severe thunderstorms, tornadoes, winter storms, wildfires, earthquakes, landslides, dam failure, drought and extreme temperatures.
- Regional hazard loss estimates indicated that hurricanes and tropical storms should be considered the area's greatest long-term hazard threat, followed by floods, drought and severe thunderstorms.
- Based on the combination of the qualitative and quantitative vulnerability assessments, the region's high risk hazards include hurricanes and tropical storms, floods and winter storms. Moderate risk hazards include severe thunderstorms, tornadoes, drought wildfires and earthquakes. Low risk hazards include extreme heat/cold, dam failure and landslide.

During the presentation, committee members were encouraged to be critical, ask questions, clarify any potential data inaccuracies and stimulate discussion on the material presented. Following the presentation of the risk assessment findings, an interactive session was held to address questions and discuss potential concerns. In addition, each workshop attendee was issued a survey form entitled, "*Identification of Hazards Unique to Individual Jurisdictions*" designed to capture data on hazards not identified in the risk assessment presentation.

Most of the questions raised at this point of the meeting were related to the data sources for information used to generate the loss estimation results. In response to these questions, PBS&J staff further explained the methodologies used to conduct both the qualitative and quantitative risk assessments. PBS&J also reiterated the importance of acquiring best available local data from the government officials representing the participating jurisdictions (including historical hazard data as well as specific local GIS data layers). The members of the Northern Virginia Hazard Mitigation Planning Committee discussed the ranking of hazards, especially flood, earthquakes, dam failure, drought, severe thunderstorms and tornadoes in light of some known data limitations, particularly those associated with FEMA's HAZUS-MH loss estimation methodology. After discussing the local perspective and impact of these hazards, the Committee decided to maintain the rankings as presented until further data could be collected and analyzed by PBS&J or in the process of conducting future plan updates.

Capability Assessment Findings

- All jurisdictions participate in the National Flood Insurance Program (NFIP).
- Six jurisdictions participate in the NFIP's Community Rating System (CRS), including Arlington County (Class 9); Fairfax County (Class 8); Loudoun County (Class 10); Prince William County (Class 8); Alexandria (Class 8); and Vienna (Class 9).

[3] For more detailed information on the findings presented at the Mitigation Strategy Workshop, please refer to Section 5: Hazard Analysis and Section 6: Vulnerability Assessment, as well as the detailed PowerPoint presentation slides available through the NVRC upon request.

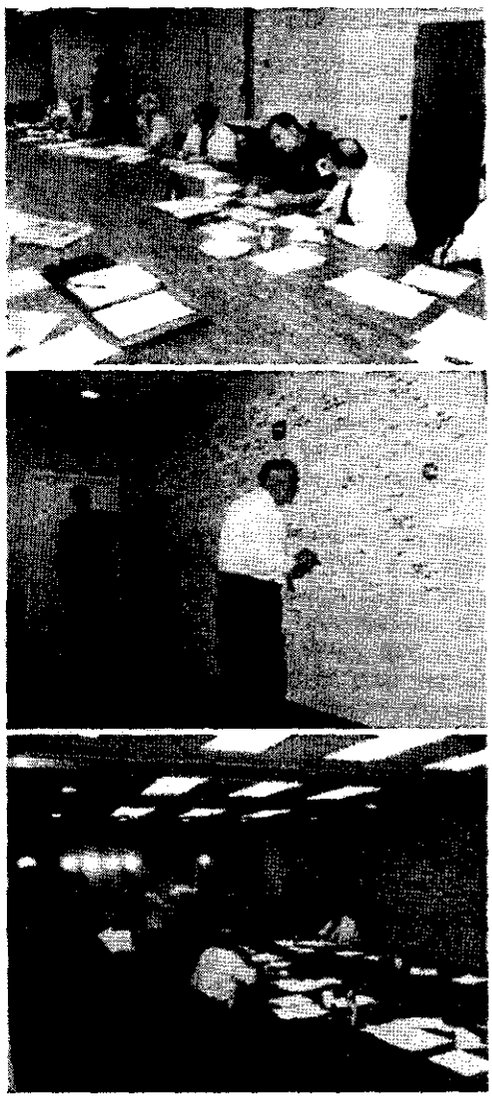
- All jurisdictions with the exception of Vienna have had an evaluation performed by Insurance Service Office, Inc. according to the Building Code Effectiveness Grading Schedule (BCEGS), with what are determined to be very positive ratings (Class 3, 4, 5).
- Most jurisdictions surveyed were determined to have a high degree of planning and regulatory capability, while the larger jurisdictions typically have higher administrative, technical and fiscal capabilities.
- All jurisdictions surveyed were determined to have either a high or moderate overall capability rating according to the evaluation performed by PBS&J.[4]

Cardstorming Exercise

Upon completing the presentation and discussions on the findings of the risk and capability assessments, PBS&J facilitated a "cardstorming" exercise – an interactive brainstorming session for workshop attendees to begin building general region-wide consensus on the mitigation goals to adopt as part of the Hazard Mitigation Plan. Participants were asked to identify specific mitigation actions that their community could undertake to help the Northern Virginia region become less vulnerable to the hazards identified through the risk assessment. Each participant was encouraged to keep their own jurisdiction's existing capabilities in mind, to not only ensure that the mitigation actions they recommend are achievable but to also capitalize on existing gaps, weaknesses or opportunities for program enhancement.

As part of the exercise, workshop participants were asked to discuss potential mitigation policies or projects with official representatives from their community and instructed to record their proposed mitigation actions on adhesive cards that would then be posted along the front wall of the meeting room. This exercise resulted in a variety of potential mitigation strategies, goals or actions being submitted and posted on the wall for further review, discussion and consideration by the committee as a whole. Community officials used this time to elaborate upon each of their proposed mitigation action items, and to share concerns and thoughts related to similarities and differences across the region as a group.

The cardstorming technique required input from every workshop participant and resulted in both broad and very specific types of proposed mitigation actions for inclusion in the Mitigation



The Mitigation Planning Committee proposed a variety of possible mitigation actions to consider during the cardstorming exercise.

[4] Detailed information on the capability assessment is provided in Section 7: Capability Assessment.

Strategy portion of the Plan. Following the open discussion, the exercise continued with the categorization of each mitigation action according to the general consensus of the group. Using the cards placed along the wall, workshop participants began to arrange the mitigation actions into agreed-upon columns that represented separate mitigation categories. The intended purpose of this categorization was the identification of common themes that could then translate logically into regional goal statements for the Mitigation Plan.

Upon completion of the exercise, six different categories were identified and labeled with separate column headings generated by consensus of the group. Workshop participants were informed that these categories would later serve as the basis for goal statements for the Mitigation Plan. These categories included the following:

- **Data**
- **Finance**
- **Planning**
- **Policy**
- **Projects**
- **Public Information**

Another outcome of the cardstorming exercise was the preliminary identification of potential mitigation actions for NVRC and its participating counties and municipal jurisdictions to consider for incorporation into their own individual Mitigation Action Plans. These actions are summarized in **Table 2.2**.

Table 2.2
Potential Mitigation Actions for the Northern Virginia Region

Proposed Action	Category	Hazard	Proposing Jurisdiction
Improve coordination of GIS data between County, Manassas and Manassas Park	Data	All	Manassas
Digitize house values / cost	Data	All	Manassas
Update floodplain maps	Data	Flood	Fairfax County
Update floodplain maps	Data	Flood	Manassas
Update floodplain maps	Data	Flood	Vienna
Update floodplain maps	Data	Flood	Alexandria
Update floodplain maps	Data	Flood	Herndon
Identify government sites for hardening and security measures	Data	Terrorism	Falls Church
Update floodplain management plans	Data	Flood	Arlington
Update floodplain maps	Data	Flood	Leesburg
Identify at-risk populations near EHS facilities	Data	Hazardous Materials	Falls Church
Prepare future land use map	Data	Flood	Fairfax (city)
Improve GIS capabilities	Data	All	Herndon
Improve floodplain data for GIS	Data	Flood	Vienna
Improve financing to respond to local hazard mitigation / disaster recovery needs	Finance	All	Vienna
Fund specific stormwater improvement projects	Finance	Flood	Fairfax County
Seek grant funding opportunities	Finance	All	Herndon

Proposed Action	Category	Hazard	Proposing Jurisdiction
Develop Government Continuity of Operations Plans	Planning	Weather	Arlington
Create Flood Response Plan	Planning	Flood	Vienna
Complete Hazard Mitigation Plan	Planning	All	Manassas
Create Floodplain Management Plan	Planning	Flood	Vienna
Complete Evacuation Plan	Planning	All	Manassas
Develop Evacuation Plan	Planning	Weather	Arlington
Develop Disaster Recovery Plan / Redevelopment / Reconstruction Ordinance	Planning	All	Vienna
Develop model "shelter-in-place" plans	Planning	Weather	Arlington
Develop / enhance sheltering program	Planning	All	Manassas
Create comprehensive stormwater management plan to deal with major storm events	Planning	Flood	Vienna
Develop transportation evacuation policy / measures	Planning	All	Herndon
Certify additional shelter capacity	Planning	Weather	Arlington
Fire / rescue strategic deployment of resources	Planning	All	Manassas
Develop / improve snow removal for major snowfalls (12"+) in historic district	Planning	Winter Storms	Leesburg
Complete open space management plan - plan open space adjacent to hazard areas	Planning	All	Prince William County
Address major structural fire hazards in EOP	Planning	Fires	Falls Church
Update BCEGS (goal to go from 4 to 3)	Planning	Multiple	Fairfax (city)
Develop a regional EOC / regional backup facility	Policy	Weather	Arlington
Create office of emergency management	Policy	All	Manassas
Link regional EOC with local EOC's	Policy	All	Manassas
Join the NFIP's Community Rating System (CRS)	Policy	Flood	Herndon
Join the NFIP's Community Rating System (CRS)	Policy	Flood	Manassas
Join the NFIP's Community Rating System (CRS)	Policy	Flood	Fairfax (city)
Enhance / update mutual aid agreements	Policy	Multiple	Prince William County
Eliminate development on steep slopes	Policy	Landslides	Leesburg
Enhance County / City communications	Policy	Multiple	Herndon
State / AW to allow recreation lake/dam to be used for flood control	Policy	Flood	Alexandria
Establish a dedicated emergency manager position	Policy	All	Fairfax (city)
Train employees in Incident Management / Support Teams (IMT/IST)	Policy	Weather	Arlington
Create redundancy in emergency communication systems	Projects	All	Prince William County
Improve regional stormwater management facilities	Projects	Flood	Fairfax County
Research buy out opportunities for flood prone properties	Projects	Flood	Alexandria
Creek modifications - Neabsco & Quantico	Projects	Flood	Prince William County
Improve drainage in flood prone areas (123 & 50)	Projects	Flood	Fairfax (city)

Proposed Action	Category	Hazard	Proposing Jurisdiction
Separate combined sewers	Projects	Flood	Alexandria
Implement flood mitigation on the west side of airport	Projects	Flood	Manassas
Improve drainage at Edward Ferry & Catoctin	Projects	Flood	Leesburg
Mitigate trailer park issue - revitalization	Projects	Wind / Flood	Manassas
Upgrade EOC (equipment, communications, etc.)	Projects	Multiple	Fairfax (city)
Improve water/capabilities for downtown Herndon	Projects	All	Herndon
Enhance EOC security (building and communications)	Projects	All	Manassas
Research elevation opportunities for flood prone properties	Projects	Flood	Alexandria
Install storm sewers for old section of town	Projects	Flood	Purcellville
Install generator system for town government / police department building	Projects	Power Outage / Storms	Purcellville
Relocate town maintenance facility	Projects	Flood	Purcellville
Construct new reservoir	Projects	Flood	Purcellville
Retrofit town buildings to become more resistant to tornadoes / natural disasters	Projects	Multiple	Herndon
Install backflow prevent valves	Projects	Flood	Alexandria
Develop emergency power system for government buildings	Projects	Multiple	Herndon
Upgrade EOC	Projects	All	Arlington
Mitigate flooding of town branch along Harrison and Catoctin	Projects	Flood	Leesburg
Install generators for critical facilities	Projects	All	Prince William County
Hardened dam site access	Projects	Flood	Manassas
Enhance generating capabilities for key facilities	Projects	All	Manassas
Enhance backup communications	Projects	All	Manassas
Eliminate flooding of city branches through regular debris removal	Projects	Flood	Falls Church
Enhance public/governmental notification	Public Information	All	Manassas
Public Warning System	Public Information	Weather	Herndon
Public Warning / modern siren system	Public Information	Weather	Arlington
Update warning systems in Occoquan	Public Information	Floods / Dam Failure	Prince William County
Implement 211 or 311 citizen call centers	Public Information	Weather	Arlington
Increase public education efforts on disaster preparedness and mitigation	Public Information	Weather	Falls Church

Before the meeting concluded, PBS&J distributed and explained several final handouts for workshop participants to use in identifying specific mitigation actions for incorporation into their own respective Mitigation Action Plans. This included "Mitigation Action Worksheets" (forms for proposing individual mitigation actions), along with a variety of planning tools and reference

guides for considering and evaluating possible mitigation action alternatives[5]. Workshop participants were instructed to take these materials back to their individual jurisdictions to begin proposing and prioritizing[6] their mitigation actions for final submission to NVRC. It was explained to each of the county and municipal officials that they were expected to convene with appropriate officials to help identify additional mitigation actions. The committee determined that all Mitigation Action Worksheets should be completed and returned to NVRC by October 22, 2004.

May 24, 2005
Community Workshop – Phase Three (Draft Plan Review)
Northern Virginia Hazard Mitigation Planning Committee

The third meeting of the Northern Virginia Hazard Mitigation Planning Committee meeting was held on **May 24, 2005**, during which the draft Hazard Mitigation Plan was reviewed, discussed and further prepared for final submission to VDEM and FEMA. The draft Plan had been made available to committee members for review in advance of the meeting through a dedicated FTP site.

Members of the NVRC Hazard Mitigation Planning Committee met on May 24, 2005 to discuss the draft Regional Hazard Mitigation

At the meeting, PBS&J provided an overview of each section of the Plan while addressing review comments from local officials of each participating jurisdiction. The committee also heard from several VDEM staff in attendance at the meeting to provide state-level support and guidance in meeting the federal DMA 2000 requirements. After going through each section of the draft Plan, the committee held a forum for open critique and discussion of the draft Plan documents. This forum highlighted the need for some minor required revisions, as well as more significant concerns regarding the quality of best available data. Possible enhancements to the risk assessment through the acquisition of better data (as well as reformatted or labeling certain data for municipal jurisdictions) was identified as a critical need for NVRC and PBS&J to address. Other items discussed included how to finalize the mitigation action plans at the local government level, as well as local adoption and plan maintenance procedures.

Following the meeting, a target date of July 8, 2005 was established for PBS&J to complete a final Hazard Mitigation Plan. Specific instructions were issued by NVRC staff to local officials from each participating jurisdiction to provide final, written review comments on the draft Plan no later than June 20, 2005. They were strongly encouraged to meet with their appropriate agency, executive and elected officials to gain additional support for the draft Plan prior to its submission for state and federal approval, particularly with regard to the proposed mitigation actions in their individual mitigation action plans. Feedback was also requested on how each jurisdiction planned to integrate the plan into their other local planning procedures and tracking mechanisms.

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[5] Copies of all planning tools and reference guides distributed at the meeting are available through the NVRC upon request.

[6] It was agreed by the NVRC Hazard Mitigation Planning Committee that prioritizing mitigation actions was to be based on the following five (5) factors: (1) effect on overall risk to life and property; (2); ease of implementation; (3) political and community support; (4) a general economic cost/benefit review; and (5) funding availability.

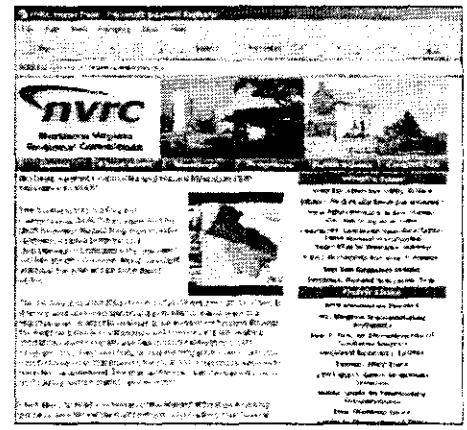
Involving the Public

> **44 CFR Requirement**
>
> **Part 201.6(b)(1):** *The planning process shall include an opportunity for the public to comment on the plan during the drafting stage and prior to plan approval.*

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

Public input on the Northern Virginia Regional Hazard Mitigation Plan was sought at two distinct periods of the planning process: (1) upon completion and publication of an acceptable draft Plan; and (2) upon completion of a final Plan but prior to official plan approval by NVRC and participating jurisdictions.

Upon completion of the draft Plan, all Plan documents were advertised and made available for review by means on the NVRC Web site as well as those Web sites of local jurisdictions. Hard copies of plan documents were also made available at the NVRC office in Fairfax for those persons without Internet access. Additional advertisements and general notifications on the posting and availability of the draft Plan for public review were disseminated by NVRC and its participating jurisdictions through e-mail messages and the posting of flyers in public buildings. These opportunities provided the public and identified stakeholders with the chance to review and comment on all sections of the Plan during the drafting stage.



The draft Plan was posted to the NVRC Web site for public review and comment.

Upon completion of a final Plan, each participating local jurisdiction scheduled and held an open public meeting (or public hearing) on the Northern Virginia Regional Hazard Mitigation Plan. These meetings provided further opportunities for the public and identified stakeholders to review and comment on all sections of the Plan prior to local approval and adoption.

Involving Stakeholders

A range of stakeholders were invited and encouraged to participate in the development of the Northern Virginia Regional Hazard Mitigation Plan. Stakeholder involvement was encouraged through NVRC's notifications and invitations to neighboring communities and select agencies or individuals to participate in Hazard Mitigation Planning Committee meetings. These agencies included representatives of all the region's county and municipal governments and representatives from the Virginia Department of Emergency Management.

Coupled with the opportunities provided by NVRC and its jurisdictions for general public review and comment, these invitations provided local officials, residents, businesses, academia and other private interests in the Northern Virginia region to be involved and offer input throughout the local mitigation planning process.

44 CFR Requirement

Part 201.6(b)(2): *The planning process shall include an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process.*

The NVRC also ensured continued stakeholder involvement by reminding all participating jurisdictions to make announcements and notifications consistent with their existing local plan adoption procedures. It was left up to each participating jurisdiction and their local governing bodies to determine how and if any additional specific stakeholder groups or individuals should be involved in the planning process.

Multi-Jurisdictional Participation

The Northern Virginia Regional Hazard Mitigation Plan includes four counties, five cities and five towns (listed in the Section 1: Introduction). All participating jurisdictions signed letters of agreement stating their commitment to participate in the multi-jurisdictional planning process. To satisfy multi-jurisdictional participation requirements, local jurisdictions were required to perform the following tasks:

- Participate in mitigation planning meetings and workshops;
- Complete the local *Capability Assessment Survey*;
- Provide relevant data to NVRC for completing the regional hazard risk assessment;
- Support the development of a regional mitigation strategy, including the design and adoption of general goal statements for all jurisdictions to pursue;
- Identify completed mitigation projects, if applicable;
- Develop and adopt a local *Mitigation Action Plan*, including specific county or municipal-level proposed mitigation actions;
- Review and provide timely comments on all draft components of the Plan;
- Adopt the Northern Virginia Regional Hazard Mitigation Plan, including their specific local Mitigation Action Plan.

Through the completion of these tasks each jurisdiction fully participated with NVRC in the development of this Plan. Further, through the preparation of their own local Mitigation Action Plans, each jurisdiction was responsible for addressing their most significant hazard concerns

through actions of their own choosing. This separate component of the planning document provides the opportunity for jurisdictions to monitor and update their own specific Plan implementation responsibilities without necessarily having to meet with the Northern Virginia Hazard Mitigation Planning Committee. It also enables each of the jurisdictions to be solely responsible and accountable for those actions that apply to their jurisdiction.

COMMUNITY PROFILE

This section of the Plan provides a general overview of the Northern Virginia region. It consists of the following four subsections:

- Geography, Hydrology, and Climate
- Population, Demographics, & Economic Growth
- Transportation
- Housing

Geography, Hydrology, and Climate

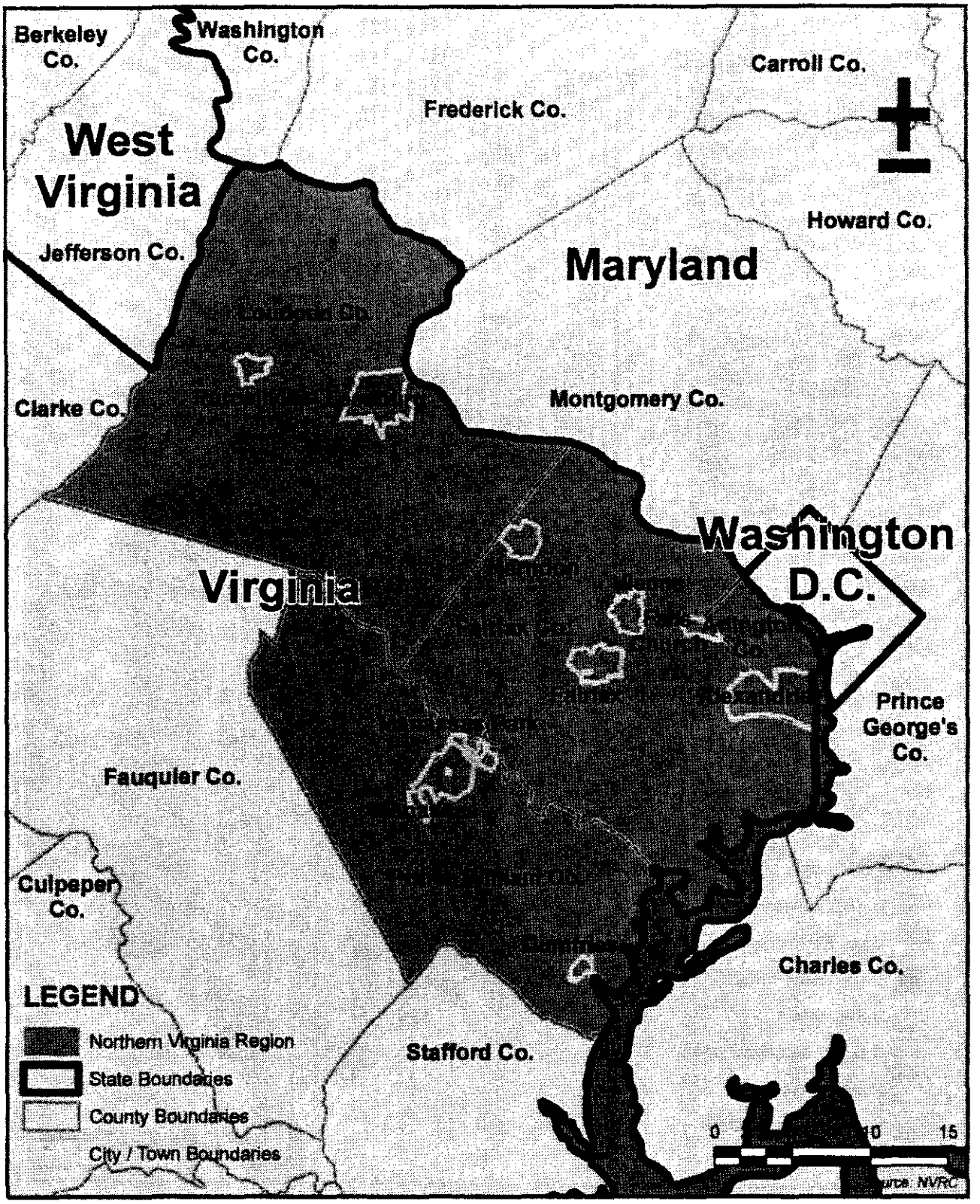
The Northern Virginia Planning District (Virginia Planning District #8) is located at the north-east corner of the Commonwealth of Virginia, lies across the Potomac River from the Nation's Capital, Washington, DC and is part of Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA). **Figure 3.1** provides an orientation map for the Northern Virginia Region including all counties, cities and towns within the region as well as the region's neighboring jurisdictions.

Northern Virginia is made up of the counties of Arlington, Fairfax, Loudoun, and Prince William; the independent cities of Alexandria, Falls Church, Fairfax, Manassas, and Manassas Park; the major towns of Dumfries (Prince William County), Herndon and Vienna (Fairfax County), and Leesburg and Purcellville (Loudoun County); and the smaller towns of Clifton (Fairfax County), Hamilton, Hillsboro, Lovettsville, Middleburg, and Round Hill (Loudoun County), and Haymarket, Occoquan, and Quantico (Prince William County). **Figure 3.2** illustrates a base map overview of the Northern Virginia region including all participating county, city and town jurisdictions as well as the identification of interstate highways, major roads, major water bodies and lands outside the authority of participating jurisdictions such as Dulles Airport and U.S. government property.

Northern Virginia is home to numerous U.S. government facilities such as the Pentagon, CIA, and USGS. Historic and cultural resources include George Washington's historic home on the Potomac, Mount Vernon, Arlington National Cemetery, and the Udvar-Hazy Center of the Smithsonian Institution's National Air and Space Museum at Washington-Dulles International Airport.

The Northern Virginia Planning District is divided by three physiographic provinces of Virginia; the Coastal Plain, the Northern Piedmont, and the Blue Ridge (**Figure 3.3**). The Coastal Plain lies roughly east of Interstate Highway-95/395 including the eastern portions of the city of Alexandria, and the counties of Fairfax, and Prince William. The Northern Piedmont province lies roughly between I-95 and US Highway 15 in central Loudoun and western Prince William counties. It is bounded by Blue Ridge Mountains on the west with ridges and foothills and hollows rolling down to the Potomac River in the east. Elevations range from more than 1,950 feet above sea level in the Blue Ridge Mountains in western Loudoun County to sea level in eastern Prince William County on the Potomac River. Total land area is 1,304 square miles.

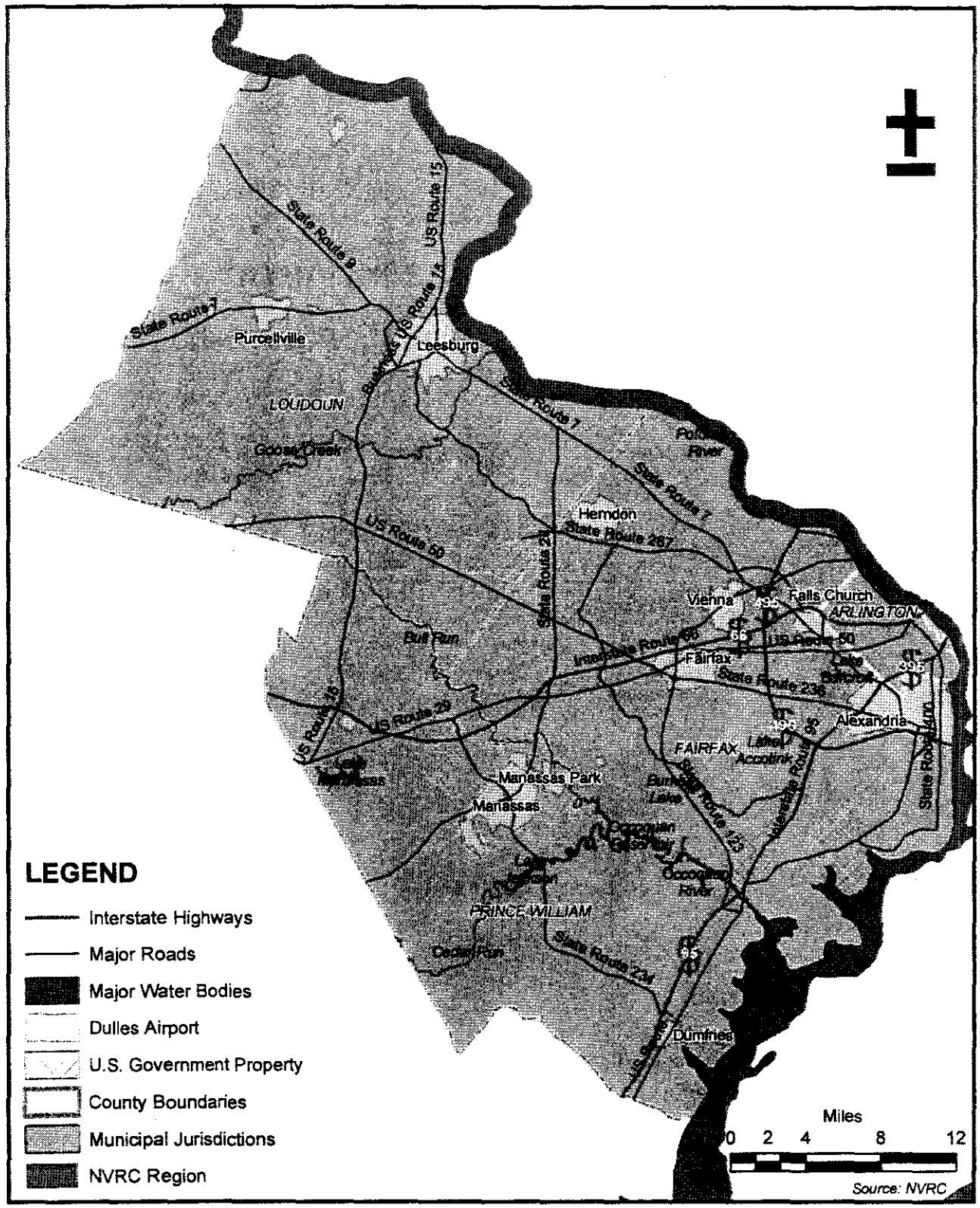
Northern Virginia lies entirely within the Potomac River watershed. After passing Harper's Ferry, WV, the Potomac forms the border between Maryland and Virginia, flowing in a southeasterly direction. The topography of the upper reaches of the basin is characterized by gently sloping hills and valleys. At Great Falls, the stream elevation rapidly descends from over 200 feet to sea level. Eastward of Great Falls, the Basin enters into the Coastal Plain physiographic province.



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 3.1

Orientation Map



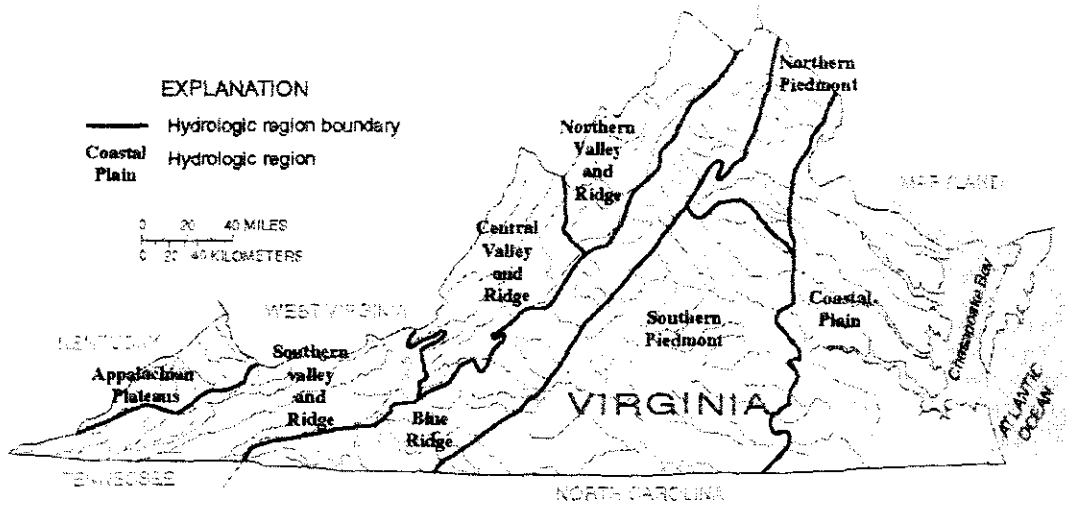
NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 3.2

Northern Virginia Region - Base Map

The area has a moderate climate. Average temperatures are approximately 50 degrees, and range from January lows in the mid-20s to July highs in the high-80s. Annual rainfall averages above 40 inches and is supplemented with approximately 14 inches of snow.

Figure 3.3
Hydrologic Regions of Virginia



Source: U.S. Department of the Interior, U.S. Geological Survey, Fact Sheet 023-01

Population, Demographics, & Economic Growth

A Populous Region that Continues to Grow and Change

Proximity to the nation's capital has been fueling population growth in Northern Virginia for more than 60 years. Since the mid-1930's when large numbers of federal workers brought to Washington, D.C. during the New Deal first began spilling out into adjoining suburbs, people have been moving into Northern Virginia at an accelerated rate. Like a water faucet turned on and left running, the flow of people has remained vigorous and constant for most of the post-war period.

Today, Northern Virginia is home to two million people. As seen in **Table 3.1**, demographers are projecting a half million more residents will be added this decade, — on average, 50,000 newcomers per year, the largest increase in the region's history — and another 275,000 the decade after. By 2020, the population should reach 2.6 million.

Table 3.1
Projected Population Growth in Northern Virginia, 2004-2020 (in millions)

Jurisdiction	2004	2010	2020	2004-2020
Alexandria	134.2	143.9	152.6	18.4
Arlington County	193.2	212.2	233.1	39.9
City of Fairfax	23.3	23.9	26.0	2.7
Fairfax County	1,007.4	1,133.0	1,193.4	186.0
Falls Church	11.2	12.3	14.7	3.5
Loudoun County	241.8	318.1	422.9	181.1
Manassas	37.0	38.0	40.2	3.2
Manassas Park	12.4	15.0	16.5	4.1
Prince William County	344.0	415.3	488.2	144.2
Northern Virginia	**2,004.5**	**2,311.7**	**2,587.6**	**583.1**

Source: Metropolitan Washington Council of Governments, Cooperative Forecasts, Draft Round 7.0

The locus of population growth, inexorably pushing outward, is now sweeping across the broad expanse of the outer rim of the Northern Virginia region. This is where the pressure to absorb new metropolitan growth is most intense, where it will remain concentrated for decades to come. More than 60 percent of the three-quarter million plus newcomers projected from 2000 to 2020 will settle in Prince William and Loudoun Counties.

When the decade of the 1960's began, Northern Virginia was a suburban bedroom community of predominantly white, middle-class families with children, not dissimilar demographically from hundreds of other places. By the end of the century, it had evolved into a complex blend of urban and suburban influences, an intricate demographic composite formed by the economic growth, transformation and prosperity of the Washington metropolitan economy, by a rising tide of immigration, by aging of the baby boom generation and by other powerful agents of social and demographic change.

What are the salient features of Northern Virginia's demographic profile, the characteristics that best define the region and distinguish it from other places in the United States?

Complex Blend of Urban and Suburban

A second salient feature of Northern Virginia's demography is the degree of urbanization etched in locality profiles.

In many ways, American suburbs have become more urban, as traffic congestion, overcrowding, immigrants, and more diverse homes and lifestyles work their way into suburbia. But urban pressures and forms, while present everywhere, have not impacted suburbia equally. The pressures are more intense, as a general role, in neighborhoods settled by the first wave of post-war suburbanization, as they age and become part of an expanding urban core.

In Northern Virginia, impacts of urbanization can be observed in the contrasting demographic profiles of close-in and outer-fringe localities. The differences can be traced, primarily, to variations in the affordability, age and composition of local housing inventories. As types of housing are unevenly distributed across regional and local landscapes, so too is the flow of different population streams as they seek a home in a location and at a price range suitable to their lifestyle, thereby stamping sections of the region with a distinctive demographic coloration.

Listed below are some of the major demographic differences found in the close-in and outer-ring suburbs of Northern Virginia.

Contrasting Demographic Profiles
Close-In and Outer-Ring Suburbs of Northern Virginia

I. **Close-in suburbs of Northern Virginia...**
(primarily, in Alexandria, Arlington County and some inside-the-beltway Fairfax neighborhoods)

- are communities that have morphed over the past three decades from conventional family-centered suburbs into new-urban enclaves that, demographically, have become similar to what you find today in downtown Manhattan, San Francisco, and other U.S. cities
- have become "first-stop" immigrant gateways
- are approaching minority-majority status
- are distinctive and stand out nationally for their high percentage of non-family households, single-person households, childless households, renters, and multi-unit apartment and hi-rise housing (of 50 or more units)
- have among the smallest percentage of school age children, and among the largest percentage of young adults (20 to 35 year old), found anywhere in the U.S.
- average household sizes also are among the smallest in the country
- have high population turnover, people continually moving in and out, with about half of the population replaced every five years
- exhibit evidence of a widening gap between have and have-nots, a Tale of Two Cities, with large numbers, mainly whites, at the high end of the income ladder; and large numbers, mainly immigrants and minorities, at the low; few in the middle.

II. **Outer-ring suburbs of Northern Virginia...**
(in Prince William and Loudoun Counties and parts of Fairfax County)

- are communities that are more traditionally suburban in character.
- have lots of families, school-age children, and homeowners who are living in detached single-family houses and townhouses
- have large average household sizes
- have growing foreign-born populations but immigrants with socio-economic backgrounds different from those pouring into the inner core. Outer suburban immigrants, generally, have lived in the U.S. longer, are better educated, are more affluent and are more likely to live in homes they own
- have fewer poor people, less evidence of a have, have-not divide; mainly a Tale of One city, many affluent, well educated homes and people; with depressed pockets and low income people to be sure, but not on the scale found closer-in

More Job Growth Projected

With a gross regional product of nearly $288 billion dollars, the Greater Washington economy is the fourth largest metro market in the United States, the seventeen largest in the world. A few quick facts underscore the strength, performance and unique structure of its economy, of which Northern Virginia is an important sub-component. Greater Washington ...

- is home to the federal government, the largest purchaser of goods and services in the world. Total value of federal procurement outlays received by businesses in the National Capital region during fiscal year 2004 was 42.2 billion, up from 12.5 billion in 1990.

- leads the nation in job growth over the past twenty years, averaging 52,000 new jobs per year, with job growth over the past five years substantially surpassing numbers achieved by other metropolitan areas in the United States. During this time period, the Washington area generated a total of 305,000 new jobs. The next closest metro was Las Vegas, NV with 150,000 new jobs (about the same number added in Northern Virginia).

- has been significantly outperforming the national economy on most basic indicators of economic activity, (i.e.. GRP growth, job growth, unemployment rates).

- has one of the lowest unemployment rates in the country (3.1% in 2004). Last year, its monthly unemployment rate was the lowest in the nation, among metro areas, for 11 of 12 months

- is the nation's third-largest center of bio-science companies; is home to 5,367 associations, the largest concentration in the nation; and employs more people in technology occupations (76,000) than any other location.

- is a top U.S. tourist destination, serving as host to 18.6 million domestic and international visitors in 2002.

- is home to a growing list of industries and advanced technologies on the vanguard of innovation. Many of the people and companies building the global communications network, for example, are located here, companies such as America ONLINE, UUNET Technologies Inc., PSINet Inc, Lockheed Martin, SPRINT, Comsat, Intelsat, GTE Spacenet and others.

Northern Virginia is a strong sub-regional component of the larger Washington economy, as are suburban Maryland and the District of Columbia. While all of the sub-regional markets are experiencing job growth, Northern Virginia is significantly outpacing the other two. During the 1990's, for each new job added in Suburban Maryland, Northern Virginia gained 2. This decade, the ratio has widened to 2.3 to 1.

Dr. Stephen Fuller, George Mason University, expects 2005 to record strong economic growth, adding more than 80,000 new jobs through out the metropolitan area. This will be followed by a "long-term trend of slower annual growth going forward to the end of the decade". The table below contains employment projections to 2020 developed by the Cooperative Forecasting Program of the Washington Metropolitan Council of Governments (COG).

Table 3.1
Projected Job Growth in Northern Virginia, 2000-2020

Jurisdiction	2000	2010	2220	2000-2020
Alexandria	91.4	113.3	132.5	41.1
Arlington County	188.4	217.8	254.4	66.0
City of Fairfax	27.3	31.3	5.3	8.0
Fairfax County	550.3	683.9	784.1	233.8
Falls Church	9.4	11.8	17.8	8.4
Loudoun County	87.0	153.7	212.9	125.9
Manassas	19.9	24.6	26.3	6.4
Manassas Park	2.7	4.5	4.7	2.0
Prince William County	86.8	120.3	156.8	0.0
Northern Virginia	**1,063.2**	**1,361.2**	**1,624.8**	**561.6**

Source: Metropolitan Washington Council of Governments, Cooperative Forecasts, Draft Round 7.0

Transportation

Northern Virginia and the Washington DC metropolitan area is served by an extensive transportation network. Transportation within the Northern Virginia is primarily dependent upon an network on major highways (VA Rt. 7, I-66, US50, US29/211, I-95/395, and US1) that radiate out from the urban core (Washington, DC, Arlington and Alexandria), one major circumferential highway (I-495/95, the Capital Beltway), and other primary cross-county roads such the Fairfax County Parkway and the Prince William Parkway. The Washington area's Metro primarily serves the inner localities with eleven stations in Arlington County, four stations in the City of Alexandria, and five stations in Fairfax County. The Virginia Railway Express (VRE) commuter rail system serves communities to west cutting through central Fairfax County to the cities of Manassas and Manassas Park and to the south in eastern Prince William County continuing to the City of Fredericksburg. Several bus systems (Metrobus, Alexandria's DASH, Arlington's ART, Falls Church's George, Fairfax County's Connector, Fairfax City's CUE, and Prince William's PRTC/Omniride) provide serve through out the region.

Nevertheless, these transportation systems are being strained by the growing population, housing, and employment patterns. From 1982 to 1997, population increased by 28.3 percent but vehicle miles traveled grew by 81.5 percent, according to the Texas Transportation Institute. Between 1990 and 2000, the length of the average one-way, home-to-work commute increased from 28.2 minutes to 31.7 minutes, and this number has risen further since 2000. Workers are leaving home earlier and coming home later to make up the time that it takes to get where they need to go.

The Texas Transportation Institute 2005 Urban Mobility Report shows the Metropolitan Washington region ranks as follows:

- Number 3 in average hours lost sitting in traffic (69 – 3 hours more than previous year).
- Number 3 in congestion cost per commuter ($1669 – $80 more than previous year).
- Number 4 in excess fuel consumed per commuter due to congestion (42 gallons/year – 2 gallons more than previous year).

- Number 5 in total excess gallons of fuel consumed due to congestion (88 million gallons – 4 million more than previous year)#7 Total regional congestion cost ($2.465 billion/year – $209 million more than previous year).
- Number 7 in total delay due to congestion (145 million hours/year – 9 million more than previous year). Total Delay due to congestion rank changed from #8 to #7 - worsened.

Transportation systems are key in providing effective emergency response, but can also influence the impact of natural disasters. This can be a particularly crucial issue in Northern Virginia due to the high levels of traffic congestion. In addition to more immediate needs, businesses and employees suffer economic consequences when roads are closed due to natural disasters.

Day to day traffic reports frequently report accidents or simply high volume levels that may bring a particular highway to a standstill. The attack on the Pentagon on September 11, 2001, Hurricane Isabel in 2004, and normal winter storms bring the regional highway system to a stop and taxes the transit system to the limits.

Northern Virginia, the State of Virginia, and the metropolitan area as a whole are actively addressing transportation through significant updates in regional plans, expansion of transit to areas such as Tysons Corner, Reston, and Dulles Airport, and introduction of operational measures such as HOT lanes (charging tolls on high occupancy vehicle lanes) to address congestions. However, under present development scenarios, Northern Virginia will still fall short of finding funding for its transportation needs in the tens of billions of dollars in the next twenty-five years.

Housing

A general market inventory of housing in Northern Virginia shows that there is a continual demand for affordable housing, with low vacancy rates throughout the region. Housing demand is being propelled by the highest high job growth in the United States.

A look at regional housing trends reveals the strengths and challenges of Washington's area's extremely strong economy. In 2003, the region's median housing price was $286,200 according to the National Association of REALTORS, well above that of Atlanta and Chicago but below that of New York, San Francisco, and Los Angeles, putting the Washington area in the middle of the affordability scale among major metropolitan areas. The real estate and construction industries are strong, and homebuyers are realizing outstanding returns on their investments. But the region's economic growth and job creation trends are taking a toll on housing affordability. According to a George Mason University (GMU) Center for Regional Analysis (CRA) study, the area had a deficit of 43,200 housing units in 2003, a number that is expected to grow to 218,000 by 2025. Demand for housing is outpacing availability and, combined with record low interest rates, is pushing prices up beyond the means of many area residents.

As tracked by COG, the median sales price of housing has increased 59 percent over the past six years, from $166,548 in 1997 to $265,047 in 2003. Incomes have not been keeping pace with rising housing prices. Between 1998 and 2003, incomes increased by only 17 percent, compared with a housing sales price increase of 59 percent. The Urban Institute estimates that one-quarter of the region's households are carrying unaffordable housing cost burdens. Housing construction has been pushed to outer-ring suburban jurisdictions, where prices still remain somewhat affordable, but savings are counterbalanced to some extent by the increased cost and time of commutes.

HAZARD IDENTIFICATION

The United States and its communities are vulnerable to a wide array of natural hazards that threaten life and property. These hazards include, in no particular order:

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

44 CFR Requirement

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

Some of these hazards are interrelated (i.e., hurricanes can cause flooding and tornadoes), and some consist of hazardous elements that are not listed separately (i.e., severe thunderstorms can cause lightning; hurricanes can cause coastal erosion). It should also be noted that some hazards, such as severe winter storms, may impact a large area yet cause little damage, while other hazards, such as a tornado, may impact a small area yet cause extensive damage. This section of the Plan provides a general description for each of the hazards listed above along with their hazardous elements, written from a national perspective.

Drought

Drought is a natural climatic condition caused by an extended period of limited rainfall beyond that which occurs naturally in a broad geographic area. High temperatures, high winds, and low humidity can worsen drought conditions, and can make areas more susceptible to wildfire. Human demands and actions can also hasten drought-related impacts.

Droughts are frequently classified as one of following four types:

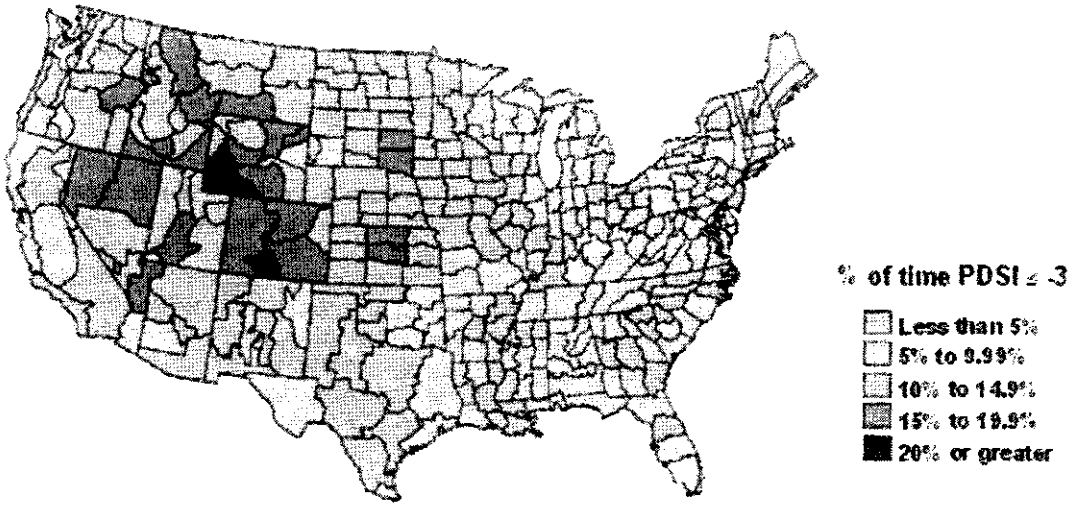
- Meteorological,
- Agricultural,
- Hydrological, and
- Socio-economic.

Meteorological droughts are typically defined by the level of "dryness" when compared to an average, or normal amount of precipitation over a given period of time. Agricultural droughts relate common characteristics of drought to their specific agricultural-related impacts. Emphasis tends to be placed on factors such as soil water deficits, water needs based on differing stages of crop development, and water reservoir levels. Hydrological drought is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land use, can alter the hydrologic characteristics of a basin. Socio-economic drought is the result of water shortages that limit the ability to supply water-dependent products in the marketplace.

A USGS streamflow gaging station at the Ogeechee River near Eden, Georgia in July 2000 illustrates the drought conditions that can severely affect water supplies, agriculture, stream water quality, recreation, navigation, and forest resources. (Photo courtesy of the United States Geological Survey)

Figure 4.1 shows the Palmer Drought Severity Index (PDSI) summary map for the United States from 1895 to 1995. PDSI drought classifications are based on observed drought conditions and range from -0.5 (incipient dry spell) to -4.0 (extreme drought). As can be seen, the Eastern United States has historically not seen as many significant long-term droughts as the Central and Western regions of the country.

Figure 4.1
Palmer Drought Severity Index, 1895-1995
Percent of Time in Severe and Extreme Drought



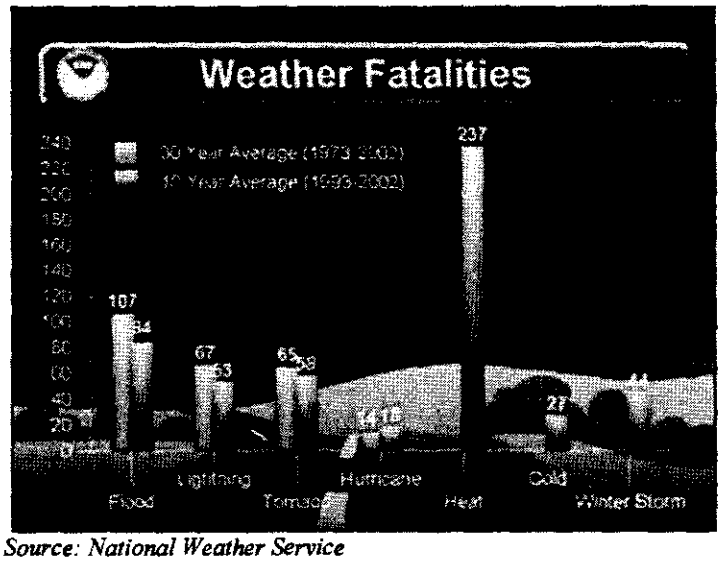
Source: National Drought Mitigation Center

Extreme Temperatures

Extreme temperatures include extreme heat and extreme cold. Extreme heat is defined as temperatures that hover ten degrees or more above the average high temperature for the region and last for several weeks. Humid conditions may also add to the discomfort of high temperatures. Under normal conditions, the human body's internal thermostat produces perspiration that evaporates and cools the body. However, in extreme heat and high humidity, evaporation is slowed and the body must work much harder to maintain a normal temperature. Health risks from extreme heat include heat cramps, heat fainting, heat exhaustion and heat stroke.

According to the National Weather Service, heat is the leading weather-related killer in the United States and has killed more people than lightning, tornadoes, floods and hurricanes combined in the last 10 years (**Figure 4.2**). However, most of these deaths are attributed to prolonged heat waves in large cities that rarely experience hot weather. Elderly persons, young children, persons with respiratory difficulties, and those who are sick or overweight are more likely to become victims of extreme heat along with those who exercise outdoors in hot, humid weather. Extreme heat in urban areas can create health concerns when stagnant atmospheric conditions trap pollutants, thus adding unhealthy air to excessively hot temperatures. In addition, the "urban heat island effect" can produce significantly higher nighttime temperatures because asphalt and concrete (which store heat longer) gradually release heat at night.

Figure 4.2
United States Weather Fatalities



Source: National Weather Service

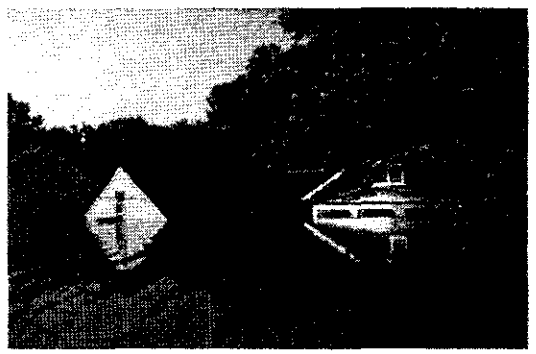
Extreme cold is associated with either Polar Regions or extreme winter storms. Communities in Polar Regions are less threatened as they are normally prepared to cope with extreme cold. The extreme cold associated with winter storms is a deceptive killer as it indirectly causes injury and death resulting from exhaustion and overexertion, hypothermia and frostbite from wind chill and asphyxiation. However, as seen in the figure above, the number of deaths attributed to extreme cold is not nearly as high as those attributed to periods of extreme heat.

Flood

Flooding is the most frequent and costly natural hazard in the United States, a hazard that has caused more than 10,000 deaths since 1900. Nearly 90 percent of presidential disaster declarations result from natural events in which flooding was a major component.

Floods are generally the result of excessive precipitation, and can be classified under two categories: general floods, precipitation over a given river basin for a long period of time; and flash floods, the product of heavy localized precipitation in a short time period over a given location. The severity of a flooding event is determined by the following: a combination of stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and the degree of vegetative clearing.

General floods are usually long-term events that may last for several days. The primary types of general flooding include riverine, coastal, and urban flooding. Riverine flooding is a function of excessive precipitation levels and water runoff volumes within the watershed of a stream or river. Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, nor'easters, and other large coastal storms. Urban flooding occurs where man-made development has obstructed the natural flow of water and decreased the ability of natural groundcover to absorb and retain surface water runoff.



A total of 534 counties in nine states were declared for federal disaster aid as a result of the Midwest Floods in June 1994. Homes, businesses and personal property were all destroyed by the high flood levels; 168,340 people registered for federal assistance. (FEMA News Photo)

Flash flooding events usually occur from a dam or levee failure within minutes or hours of heavy amounts of rainfall, or from a sudden release of water held by an ice jam. Most flash flooding is caused by slow-moving thunderstorms in a local area or by heavy rains associated with hurricanes and tropical storms. Although flash flooding occurs often along mountain streams, it is also common in urbanized areas where much of the ground is covered by impervious surfaces. Flash flood waters move at very high speeds—"walls" of water can reach heights of 10 to 20 feet. Flash flood waters and the accompanying debris can uproot trees, roll boulders, destroy buildings, and obliterate bridges and roads.

The periodic flooding of lands adjacent to rivers, streams, and shorelines (land known as floodplain) is a natural and inevitable occurrence that can be expected to take place based upon established recurrence intervals. The recurrence interval of a flood is defined as the average time interval, in years, expected between a flood event of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

Floodplains are designated by the frequency of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by the 10-year flood and the 100-year floodplain by the 100-year flood. Flood frequencies such as the 100-year flood are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. Another way of expressing the flood frequency is the chance of occurrence in a given year, which is the percentage of the probability of flooding each year. For example, the 100-year flood has a 1 percent chance of occurring in any given year.

Table 4.1 shows flood damage values by fiscal year from a national perspective.

Table 4.1
National Flood Damage by Fiscal Year (Oct-Sep)

Fiscal Year	Damage (Thousands of Current Dollars)	Implicit Price Deflator	Damage (millions of 1995 Dollars)	U.S. Population (Millions)	Damage Per Capita (1995 Dollars)
1960	111,168	0.22620	491	180.671	2.72
1961	147,680	0.22875	646	183.691	3.51
1962	86,574	0.23180	373	186.538	2.00
1963	179,496	0.23445	766	189.242	4.05
1964	194,512	0.23792	818	191.889	4.26
1965	1,221,903	0.24241	5041	194.303	25.94
1966	116,645	0.24934	468	196.560	2.38
1967	291,823	0.25698	1136	198.712	5.71
1968	443,251	0.26809	1653	200.706	8.24
1969	889,135	0.28124	3161	202.677	15.60
1970	173,803	0.29623	587	205.052	2.86
1971	323,427	0.31111	1040	207.661	5.01
1972	4,442,992	0.32436	13698	209.896	65.26
1973	1,805,284	0.34251	5271	211.909	24.87
1974	692,832	0.37329	1856	213.854	8.68
1975	1,348,834	0.40805	3306	215.973	15.31
1976	1,054,790	0.43119	2446	218.035	11.22
1977	988,350	0.45892	2154	220.239	9.78
1978	1,028,970	0.49164	2093	222.585	9.40
1979	3,626,030	0.53262	6808	225.055	30.25
1980	No data	0.58145	0	227.225	0.00
1981	No data	0.63578	0	229.466	0.00
1982	No data	0.67533	0	231.664	0.00
1983	3,693,572	0.70214	5260	233.792	22.50
1984	3,540,770	0.72824	4862	235.825	20.62
1985	379,303	0.75117	505	237.924	2.12
1986	5,939,994	0.76769	7737	240.133	32.22
1987	1,442,349	0.79083	1824	242.289	7.53
1988	214,297	0.81764	262	244.499	1.07
1989	1,080,814	0.84883	1273	246.819	5.16
1990	1,636,366	0.88186	1856	249.464	7.44
1991	1,696,765	0.91397	1859	252.153	7.37
1992	672,635	0.93619	718	255.030	2.82
1993	16,364,710	0.95872	17069	257.783	66.22
1994	1,120,149	0.97870	1145	260.327	4.40
1995	5,110,714	1.00000	5111	262.803	19.45
1996	6,121,753	1.01937	6005	265.229	22.64
1997	8,934,923	1.03925	8597	267.784	32.11
1998	2,465,048	1.05199	2343	270.248	8.67
1999	5,450,375	1.06718	5107	272.691	18.73
2000	1,336,744	1.08960	1227	282.125	4.35
2001	7,158,700	1.11539	6418	284.797	22.54

Source: National Weather Service

Hurricanes and Tropical Storms

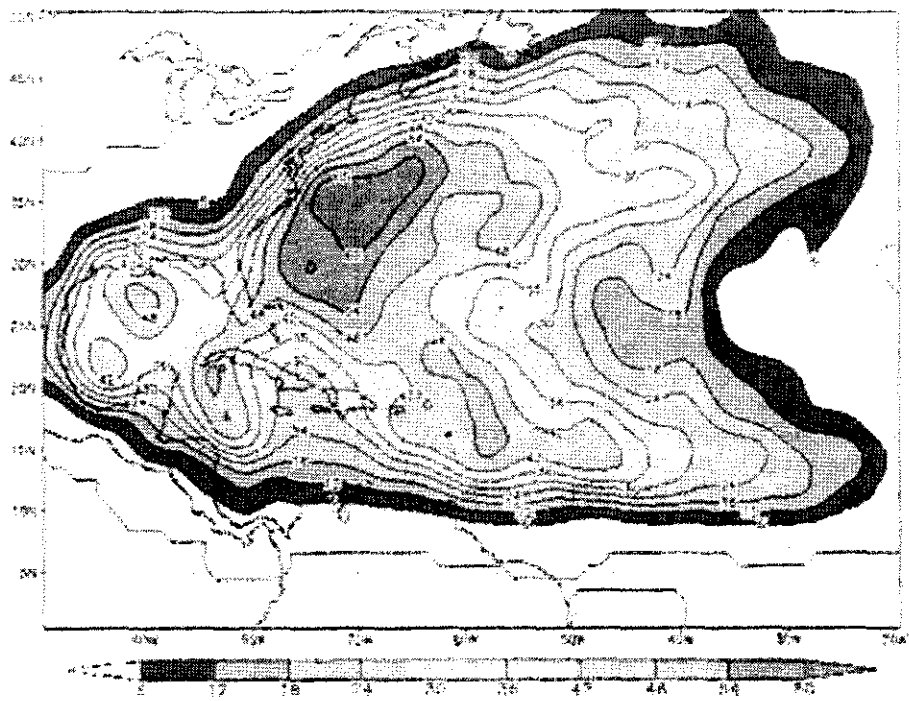
Hurricanes and tropical storms, as well as nor'easters and typhoons, are classified as cyclones and defined as any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and whose diameter averages 10 to 30 miles across. A tropical cyclone refers to any such circulation that develops over tropical waters. Tropical cyclones act as a "safety-valve," limiting the continued build-up of heat and energy in tropical regions by maintaining the atmospheric heat and moisture balance between the tropics and the pole-ward latitudes. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornadoes. Coastal areas are also vulnerable to the additional forces of storm surge, wind-driven waves, and tidal flooding which can be more destructive than cyclone wind.

The key energy source for a tropical cyclone is the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, warm sea surface temperature, rotational force from the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of the atmosphere. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season, which encompasses the months of June through November. The peak of the Atlantic hurricane season is in early to mid-September and the average number of storms that reach hurricane intensity per year in this basin is about six (6).

Wind and rain from Hurricane Lili damage road signs along I-10 in Louisiana October 3, 2002. (Photo by Lauren Hobart/FEMA News Photo)

Figure 4.3 shows for any particular location what the chance is that a tropical storm or hurricane will affect the area sometime during the whole June to November Atlantic hurricane season. The figure was created by the National Oceanic and Atmospheric Administration's Hurricane Research Division using data from 1944 to 1999 and counting hits when a storm or hurricane was within approximately 100 miles (165 km) of each location.

Figure 4.3
Empirical Probability of a Named Storm



Source: National Oceanic and Atmospheric Administration, Hurricane Research Division

As an incipient hurricane develops, barometric pressure (measured in Millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Scale, which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

The Saffir-Simpson Scale is shown in **Table 4.2**.

Table 4.2
Saffir-Simpson Scale

Category	Maximum Sustained Wind Speed (MPH)	Minimum Surface Pressure (millibars)	Storm Surge (Feet)
1	74—95	Greater than 980	3—5
2	96—110	979—965	6—8
3	111—130	964—945	9—12
4	131—155	944—920	13—18
5	155+	Less than 920	19+

Source: National Hurricane Center

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential, which are combined to estimate potential damage. Categories 3, 4, and 5 are classified as "major" hurricanes, and while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States. **Table 4.3** describes the damage that could be expected for each category of hurricane.

Table 4.3
Hurricane Damage Classification

Category	Damage Level	Description
1	MINIMAL	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage.
2	MODERATE	Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings.
3	EXTENSIVE	Some structural damage to small residences and utility buildings, with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures with larger structures damaged by floating debris. Terrain may be flooded well inland.
4	EXTREME	More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland.
5	CATASTROPHIC	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required.

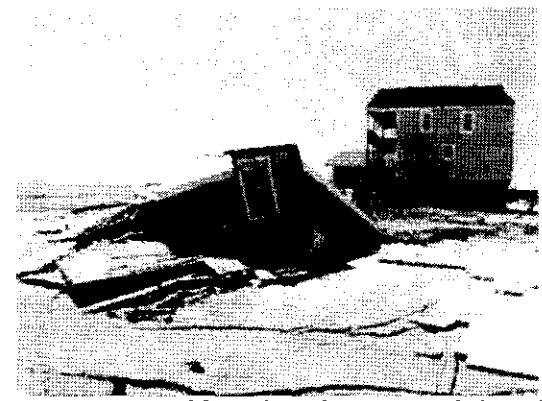
Source: National Hurricane Center

A storm surge is a large dome of water often 50 to 100 miles wide and rising anywhere from four to five feet in a Category 1 hurricane up to 20 feet in a Category 5 storm. The storm surge arrives ahead of the storm's actual landfall and the more intense the hurricane is, the sooner the surge arrives. Water rise can

be very rapid, posing a serious threat to those who have not yet evacuated flood-prone areas. A storm surge is a wave that has outrun its generating source and become a long period swell. The surge is always highest in the right-front quadrant of the direction in which the hurricane is moving. As the storm approaches shore, the greatest storm surge will be to the north of the hurricane eye. Such a surge of high water topped by waves driven by hurricane force winds can be devastating to coastal regions, causing severe beach erosion and property damage along the immediate coast.

Storm surge heights, and associated waves, are dependent upon the shape of the continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water close to the shoreline, tends to produce a lower surge but higher and more powerful storm waves.

Damage during hurricanes may also result from spawned tornadoes and inland flooding associated with heavy rainfall that usually accompanies these storms. Hurricane Floyd, as an example, was at one time a Category 4 hurricane racing towards the North Carolina coast. As far inland as Raleigh, the state capital located more than 100 miles from the coast, communities were preparing for extremely damaging winds exceeding 100 miles per hour. However, Floyd made landfall as a Category 2 hurricane and will be remembered for causing the worst inland flooding disaster in North Carolina's history. Rainfall amounts were as high as 20 inches in certain locales and 67 counties sustained damages.



Hurricane Floyd brought a devastating 15 feet of storm surge that damaged or destroyed hundreds of houses along the ocean front of Long Beach on Oak Island, North Carolina in September 1999. A prime example of successful hazard mitigation, the elevated home (right) survived while the older, ground-level block foundation of the home on the left was crushed. (Photo by Dave Gatley/FEMA News Photo)

Similar to hurricanes, nor'easters are ocean storms capable of causing substantial damage to coastal areas in the Eastern United States due to their associated strong winds and heavy surf. Nor'easters are named for the winds that blow in from the northeast and drive the storm up the East Coast along the Gulf Stream, a band of warm water that lies off the Atlantic coast. They are caused by the interaction of the jet stream with horizontal temperature gradients and generally occur during the fall and winter months when moisture and cold air are plentiful.

Nor'easters are known for dumping heavy amounts of rain and snow, producing hurricane-force winds, and creating high surfs that cause severe beach erosion and coastal flooding. There are two main components to a nor'easter: (1) a Gulf Stream low-pressure system (counter-clockwise winds) generated off the southeastern U.S. coast, gathering warm air and moisture from the Atlantic, and pulled up the East Coast by strong northeasterly winds at the leading edge of the storm; and (2) an Arctic high-pressure system (clockwise winds) which meets the low-pressure system with cold, arctic air blowing down from Canada. When the two systems collide, the moisture and cold air produce a mix of precipitation and have the potential for creating dangerously high winds and heavy seas. As the low-pressure system deepens, the intensity of the winds and waves will increase and cause serious damage to coastal areas as the storm moves northeast.

Table 4.4 shows an intensity scale proposed for nor'easters that is based upon levels of coastal degradation.

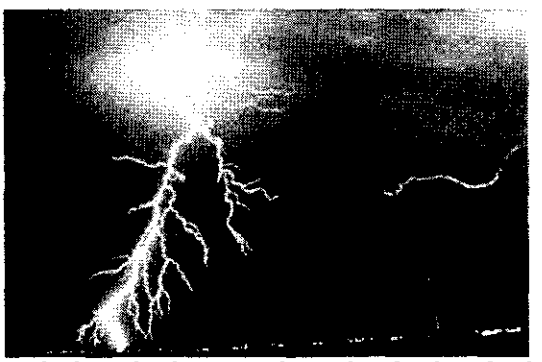
Table 4.4
Dolan-Davis Nor'easter Intensity Scale

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

Source: North Carolina Division of Emergency Management

Severe Thunderstorms

According to the National Weather Service, more than 100,000 thunderstorms occur each year, though only about 10 percent of these storms are classified as "severe." Although thunderstorms generally affect a small area when they occur, they are very dangerous because of their ability to generate tornadoes, hailstorms, strong winds, flash flooding, and damaging lightning. While thunderstorms can occur in all regions of the United States, they are most common in the central and southern states because atmospheric conditions in those regions are most ideal for generating these powerful storms.



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

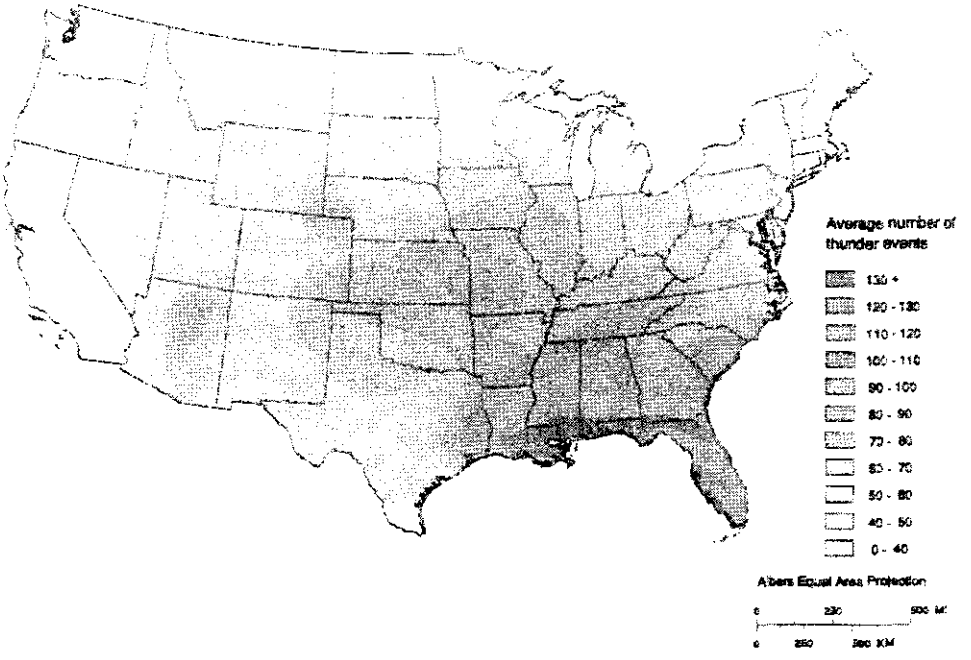
Thunderstorms are caused when air masses of varying temperatures meet. Rapidly rising warm moist air serves as the "engine" for thunderstorms. These storms can occur singularly, in lines, or in clusters. They can move through an area very quickly or linger for several hours.

Lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm, creating a "bolt" when the buildup of charges becomes strong enough. This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000 degrees Fahrenheit. Lightning rapidly heats the sky as it flashes but the surrounding air cools following the bolt. This rapid heating and cooling of the surrounding air causes thunder. On average, 89 people are killed each year by lightning strikes in the United States.

The National Weather Service collected data for thunder days, number and duration of thunder events, and lightening strike density for the 30-year period from 1948 to 1977. A series of maps was generated showing the annual average thunder event duration, the annual average number of thunder events, and the mean annual density of lightning strikes.

Figure 4.4 illustrates thunderstorm hazard severity based on the annual average number of thunder events from 1948 to 1977.

Figure 4.4
Annual Average Number of Thunder Events



Source: Federal Emergency Management Agency

Straight-line winds, which in extreme cases have the potential to cause wind gusts that exceed 100 miles per hour, are responsible for most thunderstorm wind damage. One type of straight-line wind, the downburst, can cause damage equivalent to a strong tornado and can be extremely dangerous to aviation. **Figure 4.5** shows how the frequency and strength of extreme windstorms vary across the United States. The map was produced by the Federal Emergency Management Agency (FEMA) and is based on 40 years of tornado history and over 100 years of hurricane history. Zone IV, the darkest area on the map, has experienced both the greatest number of tornadoes and the strongest tornadoes. As shown by the map key, wind speeds in Zone IV can be as high as 250 MPH.

Figure 4.5
Wind Zones in the United States

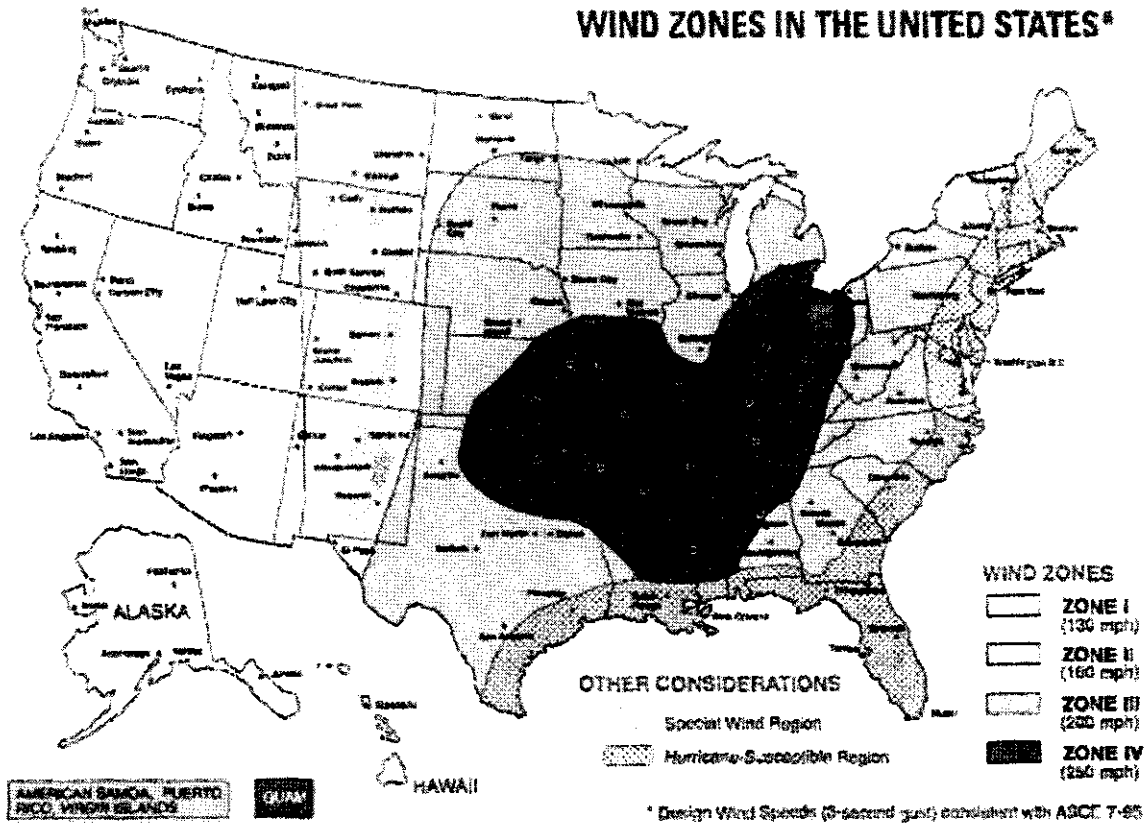
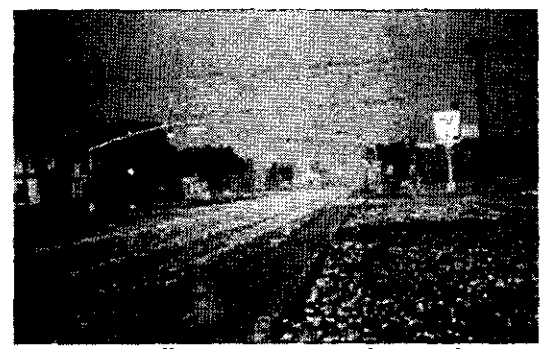


Figure 4.2 Wind zones in the United States

Source: Federal Emergency Management Agency

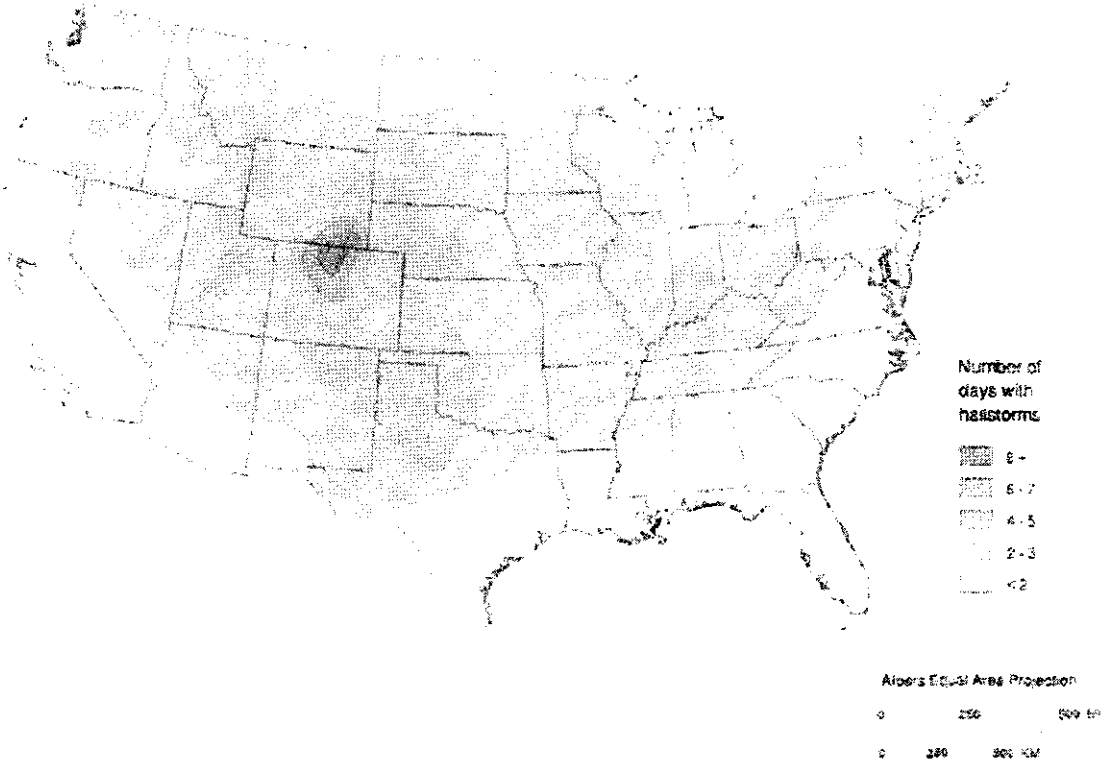
Hailstorms are another potential damaging outgrowth of severe thunderstorms. Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight, they fall as precipitation — as balls or irregularly shaped masses of ice greater than 0.75 in. (1.91 cm) in diameter. The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. Higher temperature gradients relative to elevation above the surface result in increased suspension time and hailstone size.



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

Figure 4.6 shows the annual frequency of hailstorms in the United States.

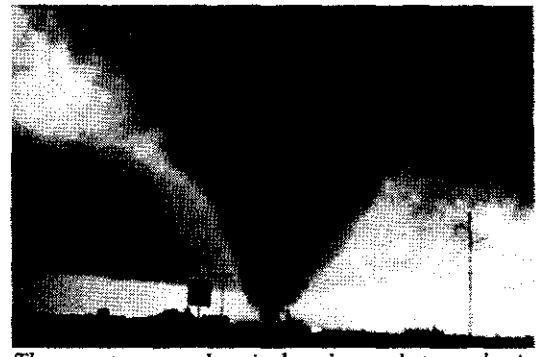
Figure 4.6
Annual Frequency of Hailstorms in the United States



Source: Federal Emergency Management Agency

Tornadoes

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes and other tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. According to the National Weather Service, tornado wind speeds normally range from 40 to more than 300 miles per hour. The most violent tornadoes have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.



The most comprehensively observed tornado in history, this tornado south of Dimmitt, Texas developed June 2, 1995 curving northward across Texas Highway 86 where it entirely removed 300 feet of asphalt from the road tossing it more than 600 feet into an adjacent field. It also caused F4 damage at an isolated rural residence just north of the road. (NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory)

Each year, an average of over 800 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries (NOAA, 2002). They are more likely to occur during the spring and early summer months of March through June and can occur at any time of day, but are likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touch down briefly, but even small short-lived tornadoes can inflict tremendous damage. Highly destructive tornadoes may carve out a path over a mile wide and several miles long.

Waterspouts are weak tornadoes that form over warm water and are most common along the Gulf Coast and southeastern states. Waterspouts occasionally move inland, becoming tornadoes that cause damage and injury. However, most waterspouts dissipate over the open water causing threats only to marine and boating interests. Typically a waterspout is weak and short-lived, and because they are so common, most go unreported unless they cause damage.

The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damages to structures of light construction such as residential homes (particularly mobile homes), and tend to remain localized in impact. The Fujita-Pearson Scale for Tornadoes was developed to measure tornado strength and associated damages, and is shown in **Table 4.5**.

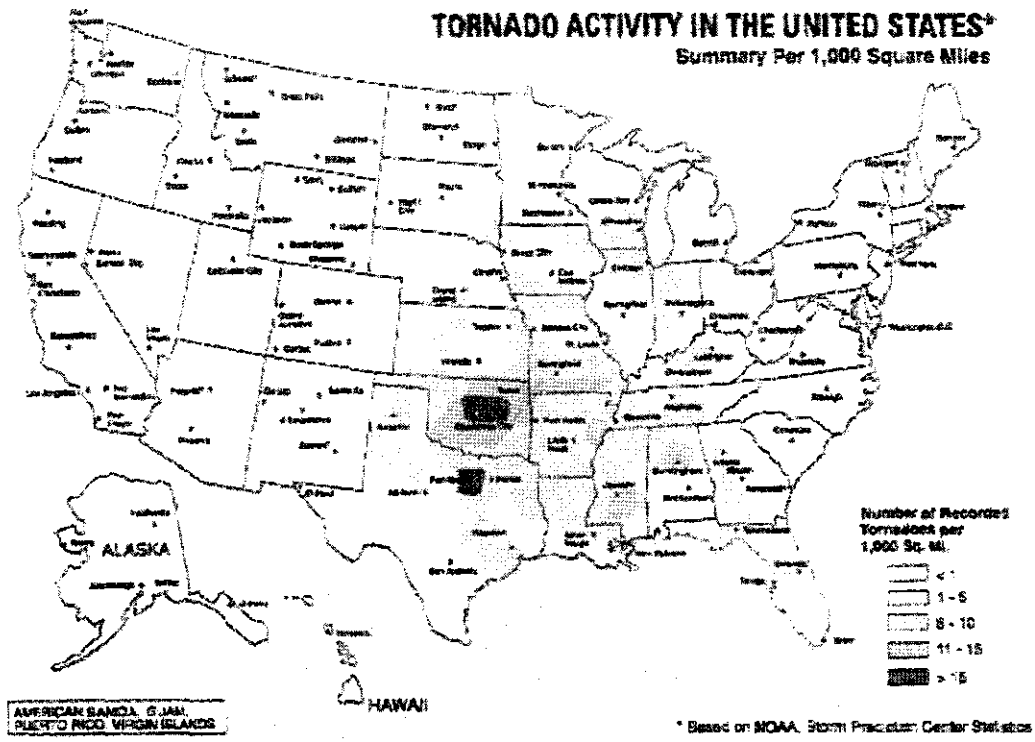
Table 4.5
Fujita-Pearson Scale for Tornadoes

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage Done
F0	Gale tornado	40-72 MPH	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
F1	Moderate tornado	73-112 MPH	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 MPH	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 MPH	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
F4	Devastating tornado	207-260 MPH	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 MPH	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.
F6	Inconceivable tornado	319-379 MPH	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

Source: The Tornado Project, 2002.

According to the NOAA Storm Prediction Center (SPC), the highest concentration of tornadoes in the United States has been in Oklahoma, Texas, Kansas and Florida respectively. Although the Great Plains region of the Central United States does favor the development of the largest and most dangerous tornadoes (earning the designation of "tornado alley"), Florida experiences the greatest number of tornadoes per square mile of all U.S. states (SPC, 2002). **Figure 4.7** shows tornado activity in the United States based on the number of recorded tornadoes per 1,000 square miles.

Figure 4.7
Tornado Activity in the United States



Source: American Society of Civil Engineers

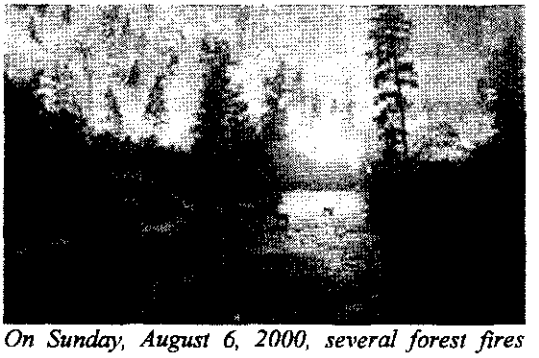
The tornadoes associated with tropical cyclones are most frequent in September and October when the incidence of tropical storm systems is greatest. This type of tornado usually occurs around the perimeter of the storm, and most often to the right and ahead of the storm path or the storm center as it comes ashore. These tornadoes commonly occur as part of large outbreaks and generally move in an easterly direction.

Wildfire

A wildfire is any fire occurring in a wildland area (i.e. grassland, forest, brush land) except for fire under prescription. (Prescription burning, or "controlled burn," undertaken by land management agencies is the process of igniting fires under selected conditions, in accordance with strict parameters.) Wildfires are part of the natural management of the Earth's ecosystems, but may also be caused by natural or human factors. Over 80 percent of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning.

There are three classes of wildland fires: surface fire, ground fire, and crown fire. A surface fire is the most common of these three classes and burns along the floor of a forest, moving slowly and killing or damaging trees. A ground fire (muck fire) is usually started by lightning or human carelessness and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees. Wildland fires are usually signaled by dense smoke that fills the area for miles around.

State and local governments can impose fire safety regulations on home sites and developments to help curb wildfire. Land treatment measures such as fire access roads, water storage, helipads, safety zones, buffers, firebreaks, fuel breaks, and fuel management can be designed as part of an overall fire defense system to aid in fire control. Fuel management, prescribed burning, and cooperative land management planning can also be encouraged to reduce fire hazards.



On Sunday, August 6, 2000, several forest fires converged near Sula, Montana, forming a firestorm that overran 100,000 acres and destroyed 10 homes. Temperatures in the flame front were estimated at more than 800 degrees. Nevertheless, the wildlife pictured above appeared to be taking the crisis in stride, gathering near the East Fork of the Bitterroot River where it crosses under U.S. Highway 93. (Photo by John McColgan/U.S. Forest Service Firefighter)

Fire probability depends on local weather conditions, outdoor activities such as camping, debris burning, and construction, and the degree of public cooperation with fire prevention measures. Drought conditions and other natural disasters (tornadoes, hurricanes, etc.) increase the probability of wildfires by producing fuel in both urban and rural settings. Forest damage from hurricanes and tornadoes may block interior access roads and fire breaks, pull down overhead power lines, or damage pavement and underground utilities.

Many individual homes and cabins, subdivisions, resorts, recreational areas, organizational camps, businesses, and industries are located within high fire hazard areas. The increasing demand for outdoor recreation places more people in wildlands during holidays, weekends, and vacation periods. Unfortunately, wildland residents and visitors are rarely educated or prepared for the inferno that can sweep through the brush and timber and destroy property in minutes.

Winter Storms

A winter storm can range from a moderate snow over a period of a few hours to blizzard conditions with blinding wind-driven snow that lasts for several days. Some winter storms may be large enough to affect several states, while others may affect only a single community. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely impair visibility.

Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Sleet – raindrops that freeze into ice pellets before reaching the ground – usually bounce when hitting a surface and do not stick to objects; however, sleet can accumulate like snow and cause a hazard to motorists. Freezing rain is rain that falls onto a surface with a temperature below freezing, forming a glaze of ice. Even small accumulations of ice can cause a significant hazard, especially on power lines and trees. An ice storm occurs when freezing rain falls and freezes immediately upon impact. Communications and power can be disrupted for days, and even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

A freeze is weather marked by low temperatures, especially when below the freezing point (zero degrees Celsius or thirty-two degrees Fahrenheit). Agricultural production is seriously affected when temperatures remain below the freezing point.

A heavy layer of ice was more weight than this tree in Kansas City, Missouri could withstand during a January 2002 ice storm that swept through the region bringing down trees, power lines and telephone lines. (Photo by Heather Oliver/FEMA News Photo)

Erosion

Erosion is the gradual breakdown and movement of land due to both physical and chemical processes of water, wind, and general meteorological conditions. Natural, or geologic, erosion has occurred since the Earth's formation and continues at a very slow and uniform rate each year.

There are two types of soil erosion: wind erosion and water erosion. Wind erosion can cause significant soil loss. Winds blowing across sparsely vegetated or disturbed land can pick up soil particles and carry them through the air, thus displacing them. Water erosion can occur over land or in streams and channels. Water erosion that takes place over land may result from raindrops, shallow sheets of water flowing off the land, or shallow surface flow, which is concentrated in low spots. Stream channel erosion may occur as the volume and velocity of water flow increases enough to cause movement of the streambed and bank soils. Major storms such as hurricanes may cause significant erosion by combining high winds with heavy surf and storm surge to significantly impact the shoreline.

An area's potential for erosion is determined by four factors: soil characteristics, vegetative cover, topography climate or rainfall, and topography. Soils composed of a large percentage of silt and fine sand are most susceptible to erosion. As the content of these soils increases in the level of clay and organic material, the potential for erosion decreases. Well-drained and well-graded gravels and gravel-sand mixtures are the least likely to erode. Coarse gravel soils are highly permeable and have a good capacity for absorption, which can prevent or delay the amount of surface runoff. Vegetative cover can be very helpful in controlling erosion by shielding the soil surface from falling rain, absorbing water from the soil, and slowing the velocity of runoff. Runoff is also affected by the topography of the area including size, shape and slope. The greater the slope length and gradient, the more potential an area has for erosion. Climate can affect the amount of runoff, especially the frequency, intensity and duration of rainfall and storms. When rainstorms are frequent, intense, or of long duration, erosion risks are high. Seasonal changes in temperature and rainfall amounts define the period of highest erosion risk of the year.

During the past 20 years, the importance of erosion control has gained the increased attention of the public. Implementation of erosion control measures consistent with sound agricultural and construction operations is needed to minimize the adverse effects associated with increasing settling out of the soil particles due to water or wind. The increase in government regulatory programs and public concern has resulted in a wide range of erosion control products, techniques, and analytical methodologies in the United States. The preferred method of erosion control in recent years has been the restoration of vegetation.

Earthquakes

An earthquake is the motion or trembling of the ground produced by sudden displacement of rock in the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of caverns. Earthquakes can affect hundreds of thousands of square miles; cause damage to property measured in the tens of billions of dollars; result in loss of life and injury to hundreds of thousands of persons; and disrupt the social and economic functioning of the affected area.

Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends upon the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site and regional geology. Other damaging earthquake effects include landslides, the down-slope movement of soil and rock (mountain regions and along hillsides), and liquefaction, in which ground soil loses the ability to resist shear and flows much like quick sand. In the case of liquefaction, anything relying on the substrata for support can shift, tilt, rupture, or collapse.

Many roads, including bridges and elevated highways, were damaged by the 6.7 magnitude earthquake that impacted the Northridge, California area January 17, 1994. Approximately 114,000 structures were damaged and 72 deaths were attributed to the event. Damage costs were estimated at $25 billion. (FEMA News Photo)

Most earthquakes are caused by the release of stresses accumulated as a result of the rupture of rocks along opposing fault planes in the Earth's outer crust. These fault planes are typically found along borders of the Earth's ten tectonic plates. These plate borders generally follow the outlines of the continents, with the North American plate following the continental border with the Pacific Ocean in the west, but following the mid-Atlantic trench in the east. As earthquakes occurring in the mid-Atlantic trench usually pose little danger to humans, the greatest earthquake threat in North America is along the Pacific Coast.

The areas of greatest tectonic instability occur at the perimeters of the slowly moving plates, as these locations are subjected to the greatest strains from plates traveling in opposite directions and at different speeds. Deformation along plate boundaries causes strain in the rock and the consequent buildup of stored energy. When the built-up stress exceeds the rocks' strength, a rupture occurs. The rock on both sides of the fracture is snapped, releasing the stored energy and producing seismic waves, generating an earthquake.

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude (see **Table 4.6**). Each unit increase in magnitude on the Richter Scale corresponds to a ten-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, with a I corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction). A detailed description of the Modified Mercalli Intensity Scale of earthquake intensity and its correspondence to the Richter Scale is given in **Table 4.7**.

Table 4.6
Richter Scale

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

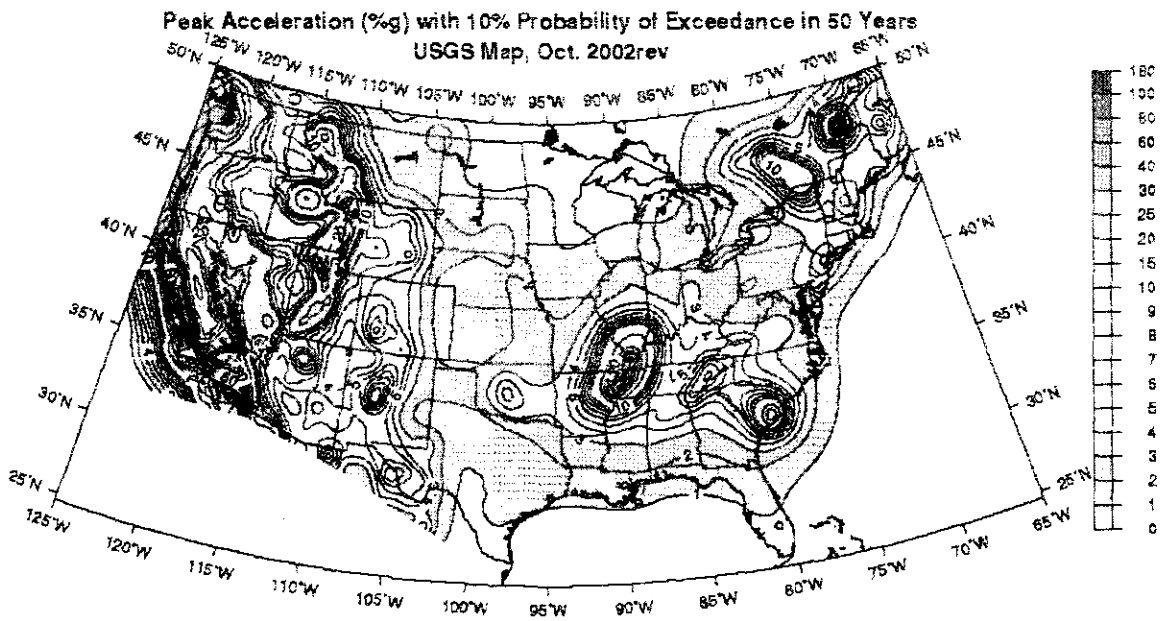
Table 4.7
Modified Mercalli Intensity Scale for Earthquakes

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	Instrumental	Detected only on seismographs	
II	Feeble	Some people feel it	<4.2
III	Slight	Felt by people resting; like a truck rumbling by	
IV	Moderate	Felt by people walking	
V	Slightly Strong	Sleepers awake; church bells ring	<4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves	<5.4
VII	Very Strong	Mild Alarm; walls crack; plaster falls	<6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open	<6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	<7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards	<8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves	>8.1

Figure 4.8 shows the probability that ground motion will reach a certain level during an earthquake. The data show peak horizontal ground acceleration (the fastest measured change in speed, for a particle at ground level that is moving horizontally due to an earthquake) with a 10 percent probability of

exceedance in 50 years. The map was compiled by the U.S. Geological Survey (USGS) Geologic Hazards Team, which conducts global investigations of earthquake, geomagnetic, and landslide hazards.

Figure 4.8
Peak Acceleration with 10 Percent Probability of Exceedance in 50 Years



Source: USGS

Sinkholes

Sinkholes are a natural and common geologic feature in areas with underlying limestone and other rock types that are soluble in natural water. Most limestone is porous, allowing the acidic water of rain to percolate through their strata, dissolving some limestone and carrying it away in solution. Over time, this persistent erosional process can create extensive underground voids and drainage systems in much of the carbonate rocks. Collapse of overlying sediments into the underground cavities produces sinkholes.

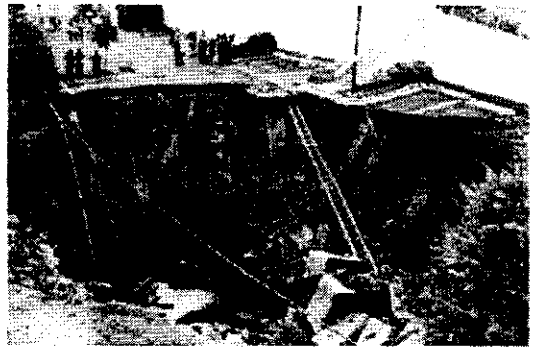
The three general types of sinkholes are: subsidence, solution, and collapse. Collapse sinkholes are most common in areas where the overburden (the sediments and water contained in the unsaturated zone, surficial aquifer system, and the confining layer above an aquifer) is thick, but the confining layer is breached or absent. Collapse sinkholes can form with little warning and leave behind a deep, steep sided hole. Subsidence sinkholes form gradually where the overburden is thin and only a veneer of sediments is overlying the limestone. Solution sinkholes form where no overburden is present and the limestone is exposed at land surface.

Sinkholes occur in many shapes, from steep-walled holes to bowl or cone shaped depressions. Sinkholes are dramatic because the land generally stays intact for a while until the underground spaces get too big. If there is not enough support for the land above the spaces, then a sudden collapse of the land surface can occur. Under natural conditions, sinkholes form slowly and expand gradually. However, human activities such as dredging, constructing reservoirs, diverting surface water, and pumping groundwater can accelerate the rate of sinkhole expansions, resulting in the abrupt formation of collapse sinkholes.

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

- Slumping or falling fenceposts, trees, or foundations;
- Sudden formation of small ponds;
- Wilting vegetation;
- Discolored well water; and/or
- Structural cracks in walls, floors.

Sinkhole formation is aggravated and accelerated by urbanization. Development increases water usage, alters drainage pathways, overloads the ground surface, and redistributes soil. According to FEMA, the number of human-induced sinkholes has doubled since 1930, insurance claims for damages as a result of sinkholes has increased 1,200 percent from 1987 to 1991, costing nearly $100 million.



Collapses, such as the sudden formation of sinkholes, may destroy buildings, roads, and utilities. (Photo: Bettmann)

Landslides

A landslide is the downward and outward movement of slope-forming soil, rock, and vegetation, which is driven by gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes due to construction or erosion, earthquakes, volcanic eruptions, and changes in groundwater levels.

There are several types of landslides: rock falls, rock topple, slides, and flows. Rock falls are rapid movements of bedrock, which result in bouncing or rolling. A topple is a section or block of rock that rotates or tilts before falling to the slope below. Slides are movements of soil or rock along a distinct surface of rupture, which separates the slide material from the more stable underlying material. Mudflows, sometimes referred to as mudslides, mudflows, lahars or debris avalanches, are fast-moving rivers of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as heavy rainfall or rapid snowmelt, changing the soil into a flowing river of mud or "slurry." Slurry can flow rapidly down slopes or through channels, and can strike with little or no warning at avalanche speeds. Slurry can travel several miles from its source, growing in size as it picks up trees, cars, and other materials along the way. As the flows reach flatter ground, the mudflow spreads over a broad area where it can accumulate in thick deposits.

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly.

Among the most destructive types of debris flows are those that accompany volcanic eruptions. A spectacular example in the United States was a massive debris flow resulting from the 1980 eruptions of Mount St. Helens, Washington. Areas near the bases of many volcanoes in the Cascade Mountain Range of California, Oregon and Washington are at risk from the same types of flows during future volcanic eruptions.

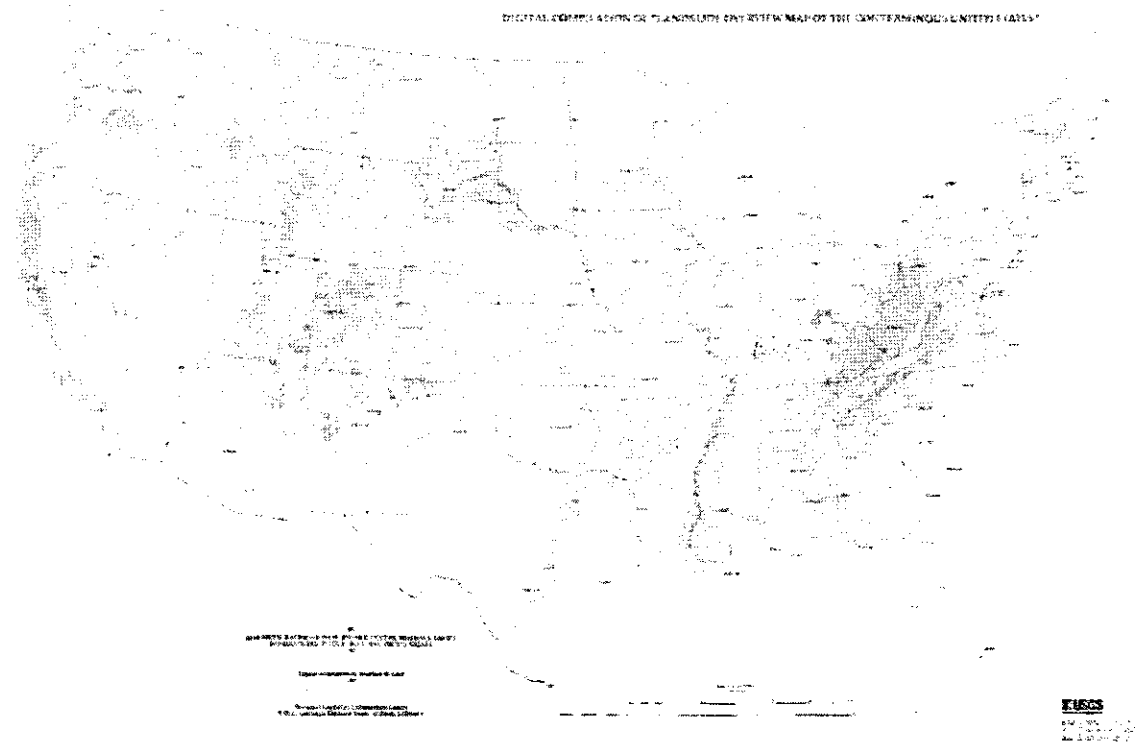
Areas that are generally prone to landslide hazards include previous landslide areas; the bases of steep slopes; the bases of drainage channels; and developed hillsides where leach-field septic systems are used. Areas that are typically considered safe from landslides include areas that have not moved in the past; relatively flat-lying areas away from sudden changes in slope; and areas at the top or along ridges, set back from the tops of slopes.

Landslides can damage or destroy roads, railroads, pipelines, electrical and telephone lines, mines, oil wells, buildings, canals, sewers, bridges, dams, seaports, airports, forests, parks, and farms. (Photo by Lynn Forman)

In the United States, it is estimated that landslides cause up to $2 billion in damages and from 25 to 50 deaths annually. Globally, landslides cause billions of dollars in damage and thousands of deaths and injuries each year.

Figure 4.9 delineates areas where large numbers of landslides have occurred and areas which are susceptible to landsliding in the conterminous United States. This map layer is provided in the U.S. Geological Survey Professional Paper 1183, Landslide Overview Map of the Conterminous United States.

Figure 4.9
Landslide Overview Map of the Conterminous United States



EXPLANATION

LANDSLIDE INCIDENCE

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

LANDSLIDE SUSCEPTIBILITY/INCIDENCE

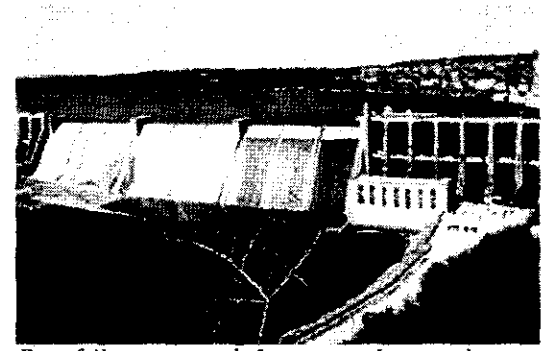
- Moderate susceptibility/low incidence
- High susceptibility/low incidence
- High susceptibility/moderate incidence

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

Source: USGS

Dam/Levee Failure

Worldwide interest in dam and levee safety has risen significantly in recent years. Aging infrastructure, new hydrologic information, and population growth in floodplain areas downstream from dams and near levees have resulted in an increased emphasis on safety, operation and maintenance.



Dam failure can result from natural events, human-induced events, or a combination of the two. Failures due to natural events such as hurricanes, earthquakes or landslides are significant because there is generally little or no advance warning. The most common cause of dam failure is prolonged rainfall that produces flooding. (Photo: Michael Baker Corporation)

There are about 80,000 dams in the United States today, the majority of which are privately owned. Other owners include state and local authorities, public utilities, and federal agencies. The benefits of dams are numerous: they provide water for drinking, navigation, and agricultural irrigation. Dams also provide hydroelectric power, create lakes for fishing and recreation, and save lives by preventing or reducing floods.

Though dams have many benefits, they also can pose a risk to communities if not designed, operated, and maintained properly. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and great property damage if development exists downstream of the dam. If a levee breaks, scores of properties are quickly submerged in floodwaters and residents may become trapped by this rapidly rising water. The failure of dams and levees has the potential to place large numbers of people and great amounts of property in harm's way.

Data Sources

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

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

Federal Emergency Management Agency (FEMA)
Web site: www.fema.gov

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

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

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

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

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

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

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

HAZARD ANALYSIS

The Hazard Analysis section focuses on hazards initially identified in the *Hazard Identification* section that are of particular concern and relevance to the Northern Virginia region. It provides best available information on significant historical events in the region and also describes the future potential for a hazard event to occur. When possible, this includes an assessment of the location and spatial extent of potential hazards as well as best available data regarding notable historical damages across the region.

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

44 CFR Requirement

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

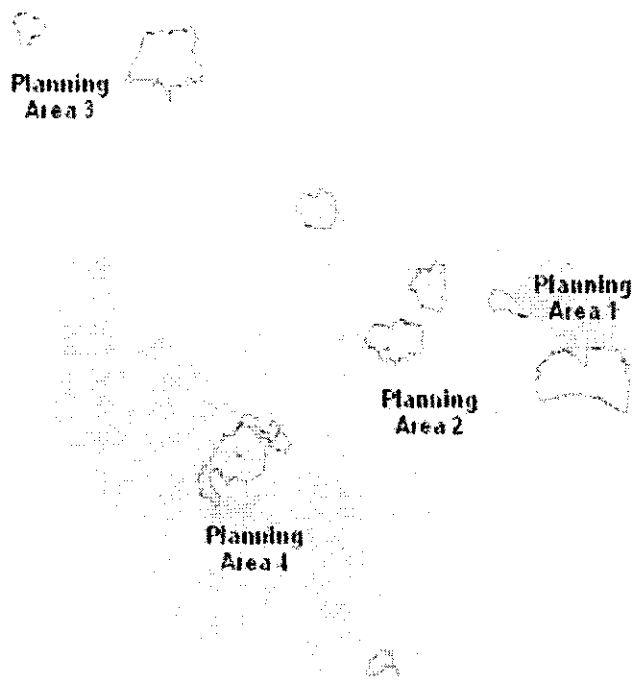
To a large extent, historical records are used to identify the level of risk within the Northern Virginia region with the assumption that the data sources cited are reliable and accurate. Unless otherwise cited, all data on historical weather-related events are based on information made available through the Storm Event Database by National Oceanic and Atmospheric Administration's (NOAA) National Climate Data Center[1] (NCDC). From a regional planning perspective, it is important to use a consistent source for hazard-related data such as the NCDC. That being said, descriptions of historical hazard events and numerical damage data are based on the collection of information reported by local offices of the National Weather Service and should only be considered approximate figures for general analysis and planning purposes[2].

[1] NCDC's Storm Event database is available at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms.
[2] More information on the calculation of estimated historical property damages is provided in Section 6: Vulnerability Assessment (under "Methodologies Used").

Designated Planning Areas

Whenever possible, hazard-related data is provided in this Plan for each participating jurisdiction at their specific geographic level. However, limitations on the availability of historical damage data through NCDC for each individual jurisdiction required the creation of four (4) distinct planning areas within the Northern Virginia region to properly aggregate and summarize historical hazard events and damage figures. These designated planning areas are described below and are referred to throughout Sections 5 and 6 of the Plan[3].

Planning Area 1:	Arlington County
Planning Area 2:	Fairfax County, City of Alexandria, City of Fairfax, City of Falls Church, Town of Herndon, Town of Vienna
Planning Area 3:	Loudoun County, Town of Leesburg, Town of Purcellville
Planning Area 4:	Prince William County, City of Manassas, City of Manassas Park, Town of Dumfries



[3] Planning area boundaries are also designated by white lines on each of the regional maps included in Section 5 and Section 6.

Summary of Presidential Disaster Declarations

Since 1965[4], the Northern Virginia region has experienced presidential disaster declarations for eleven disaster events (**Table 5.1**). These declarations are issued for county (including towns) or independent city jurisdictions when an event has been determined to be beyond the capabilities of state and local governments to respond. The region has also experienced a significant number of additional emergencies and disasters that were not severe enough to require federal disaster relief through a presidential declaration.

Table 5.1
Presidential Disaster Declarations for the Northern Virginia Region, 1965–2004

Date of Declaration	Disaster	Declared Jurisdiction								
		Arlington County	Fairfax County	Loudoun County	Prince William County	Alexandria, City of	Fairfax, City of	Falls Church, City of	Manassas, City of	Manassas Park, City of
9/18/2003	Hurricane Isabel	✓	✓	✓	✓	✓	✓	✓	✓	✓
3/27/2003	Severe Winter Storm	✓	✓	✓	✓	✓	✓	✓	✓	✓
9/21/2001	Terrorism	✓								
2/28/2000	Severe Winter Storm	✓	✓	✓	✓	✓	✓		✓	
10/12/1999	Hurricane Floyd		✓				✓			
10/23/1996	Hurricane Fran				✓					
2/2/1996	Blizzard of 1996	✓	✓	✓	✓	✓	✓	✓	✓	✓
11/10/1985	Severe Storms & Flooding					✓				
10/10/1972	Severe Storms & Flooding					✓				
10/7/1972	Severe Storms & Flooding					✓				
6/29/1972	Tropical Storm Agnes	✓	✓	✓	✓	✓	✓	✓		

Source: Federal Emergency Management Agency (FEMA)

[4] Prior to January 1, 1965, presidential disaster declarations did not have county or independent city designations.

Drought

The Northern Virginia region is susceptible to drought conditions, although these are typically not nearly as severe as in other regions of the country. According to historical Palmer Drought Severity Index records for the years 1895 to 1995, the Northern Virginia region was in severe to extreme drought conditions for only 5 to 10 percent of the time (See Figure 4.1 in Section 4: Hazard Identification), as compared with areas in the western portion of United States that experienced severe to extreme drought conditions for more than 20 percent of the time.

Since 1993, there have been 34 instances of drought conditions recorded by NOAA's National Climatic Data Center (NCDC). Many of these instances are considered overlapping (counted twice), as adjacent counties experiencing the same drought were considered separate instances. Also, unlike the very distinct beginning and end to other hazards (e.g. tornado), the period of a drought occurrences is not clear because multiple instances may be recorded for the same long-term drought. These instances are summarized by planning area in **Table 5.2,** and some of the more significant events are briefly described below based on information recorded by the NCDC. More detailed information on historical drought events can be obtained through the NCDC Storm Event Database as referenced on page three of this section.

Table 5.2
Historical Instances of Drought in the Northern Virginia Region, 1993–2004

Planning Area	Number of Drought Events	Estimated Crop Damage
1	7	$0
2	7	$0
3	10	$20,000,000
4	10	$5,000,000
Total	**34**	**$25,000,000**

Source: NOAA, National Climatic Data Center

Significant Historical Events:

- August 1998 – August 1999

  By the last week of July 1999, the Palmer Drought Index, a measure of long term drought conditions, indicated Northern Virginia was in an extreme drought. July was the 10th month in the past 12 that precipitation was below normal. During this period, precipitation was a staggering 10 to 16 inches below average, the 2nd driest 12 months on record.

  The lack of rainfall affected water levels along the Potomac River, the main water source for the region. Many upstream tributaries also reported extremely low water levels. For the first time, water was released from the Randolph and Little Seneca reservoirs near the Potomac headwaters to help maintain a safe water level for wildlife and human consumption. By July 31st, the Randolph Reservoir was 13.8 percent below capacity and the Little Seneca Reservoir was down 4 inches. The Occoquan Reservoir, the main water source for Southern Fairfax County, was 21 percent below capacity by the end of the month. The Beaverdam Reservoir in Loudoun County was at 50 percent capacity, still recovering from being drained to fill Goose Creek Reservoir. This reservoir, the main water source for Loudoun and half of Fairfax County, fell to 2.5 feet below the dam by the end of the month, a level officials called dangerously low. With such low water tables, most locations were forced to begin voluntary water restrictions and some locations such as Loudoun County began mandatory restrictions. Many residents located away

from the Washington, DC suburbs and larger cities became dependent on water deliveries after wells dried up.

Across Northern Virginia, several crops such as corn and soybeans never reached maturity, trees prematurely shed leaves and fruit in orchards, pasture land became nearly non-existent, and watering holes and irrigation sources dried up. Hay production in Prince William County was cut by 65 percent. During this period, Loudoun County estimated there had been $20,000,000 in agricultural losses and was declared a federal drought disaster area.

These instances of drought came to a sudden end in September, 1999 courtesy of two landfalling hurricanes that brought significant rainfall to the region. Following these storms, most areas recorded a major increase in water supplies and upgraded their condition from an extreme drought to a mild drought.

- July 1997

  This was a very dry month that included one seven-day heat wave, and exacerbated drought-like conditions across much of the fertile farmland of Northern Virginia. The weather in July proved to be the death knell for much of the crop yields, including corn, hay, alfalfa, and soybeans. Counties in the Northern Virginia region reported damage via local farms; though no formal declarations of federal emergency were received from them.

Probability of Future Occurrences:

- Based on current and seasonal outlook drought maps available through the National Weather Service's Climate Prediction Center and the National Drought Mitigation Center[5], there is no concern for imminent or forecasted drought occurrences. However, based on past events, it certainly remains possible over the long-term that the Northern Virginia region will experience recurring drought conditions when precipitation falls below normal for extended periods of time.

[5] Current and seasonal drought outlook maps are made available by the National Drought Mitigation Center at www.drought.unl.edu/dm/index.html.

Extreme Temperatures

The Northern Virginia region is susceptible to extreme heat and cold. While these temperatures extremes are most known for their threat to human health, agricultural losses are also a potentially significant impact and cause for concern (primarily in Loudoun and Prince William counties).

Since 1993, there have been 34 instances of extreme temperatures recorded by the NCDC for the Northern Virginia region. These events reportedly led to three fatalities and 129 injuries as summarized for the entire region in **Table 5.3**. More detailed information on historical extreme temperature events can be obtained through the NCDC Storm Event database as referenced on page three of this section.

Table 5.3
Historical Instances of Extreme Temperatures in the Northern Virginia Region, 1993–2004

Temperature Extreme	Number of Events	Fatalities	Injuries
Extreme Heat	24	2	129
Extreme Cold	13	1	0
Total	**37**	**3**	**129**

Source: NOAA, National Climatic Data Center

Significant Historical Events:

- January 27, 2000 (Extreme Cold)

  High pressure was located directly over the Mid-Atlantic region between the 27th and 29th. The combination of clear skies, calm winds, and a snowpack led to extremely cold temperatures that fell to below zero degrees Fahrenheit. On the 27th, a 59-year-old woman was found dead in the parking lot of a shopping center in Fairfax, an apparent victim of hypothermia.

- July 4–7, 1999 (Extreme Heat)

  High pressure sat off the Mid-Atlantic coast, drawing extremely warm and humid air into Northern Virginia. Temperatures on the 4th through early on the 7th were oppressively hot, and extremely humid conditions added to the misery. Temperatures soared into the upper 90s to lower 100s during the period, and dew points were in the lower to middle 70s, creating heat indices between 100 and 115 degrees. Overnight lows only dipped into the 70s and heat index values ranged from the upper 70s to upper 80s. The heat index only dropped to 90 degrees at National Airport in the Washington, DC suburbs on the morning of the 6th. Record highs were broken at Washington National Airport on the 5th and 6th. The record high at Dulles International Airport was broken on the 4th and tied on the 5th.

  Because of the 4th of July holiday weekend, many people were inconvenienced by the oppressive conditions. Many holiday events had low attendance, with the exception off the late evening fireworks displays which occurred after temperatures fell below 90 degrees. Those who spent considerable time outdoors were subject to heat related illnesses. The number of persons treated for heat related illnesses included at least seven in Frederick and Loudoun Counties, 24 in Fairfax County, and 21 in Alexandria. Road surfaces and cars also fell victim to the heat. A major asphalt buckle occurred on Interstate 395 between King Street and Seminary Road in the Washington, DC suburbs, closing all southbound lanes for a short time.

These conditions continued until a cold front swept through the area during the afternoon of the 7th, ushering in cooler and much less humid air.

- August 16–17, 1997 (Extreme Heat)

  West winds circulating around a "Bermuda High" pressure system allowed temperatures to soar over the weekend of the 16th and 17th. Maximum temperatures surpassed the century mark across most of Northern Virginia (except in the higher elevations) both days. Heat index values ranged from 105 to 110 each day, but aside from a few heat exhaustion cases, it appeared that at-risk residents remained in air conditioned locations. No heat-related deaths were reported by Virginia medical authorities. A record high was achieved at Washington/Dulles Airport on the 16th with a new maximum of 100 degrees. That temperature was matched on the 17th, before strong to severe thunderstorms moved through.

- April 10, 1997 (Extreme Cold)

  A record cold arctic air mass overspread the Northern Virginia piedmont and the Shenandoah Valley over night on the 9th and 10th, dropping temperatures into the upper teens to lower 20s across the entire area. These temperatures arrived on the heels of an above normal winter season, especially pronounced in late March, when peach and apple blossoms reached critical bloom stage up to 2 weeks ahead of schedule. This accelerated growth led to high kill percentages across the region, with estimates showing at least a 70 to 90 percent kill of the peach crop, and similar kills among the Red Delicious apple crop.

- July 1995 (Extreme Heat)

  A 38-hour period of extremely hot and humid weather in mid-July took its toll on humans and animals. The heat was caused by strengthening of a Bermuda High, extending from the surface to the upper levels of the atmosphere. The most life-threatening period of the heat wave occurred during the afternoon of the 15th, when temperatures ranged from 98 to 103 but heat indices were between 115 and 129. On this day, an all-time record for power usage was established in Northern Virginia, with 13,512 megawatts recorded (mostly from air conditioning usage). Five thousand customers were without power in the same general area. In Alexandria, a National Park Service bicycle patrol ranger collapsed near Daingerfield Island, then later died from complications resulting from hyperthermia.

  There were several additional instances of heat exhaustion during the remainder of the month, concentrated during the middle two weeks. Alexandria hospitals reported about 80 persons requiring treatment between the 14th and 23rd. The heat wave returned twice in late July, from the 21st through the 25th and again from the 29th through the 31st. However, temperatures were not as oppressive, ranging from 90 to 97 degrees. Daytime heat indices ranged from 105 to 115, but fell below 90 each night. No deaths or injuries were directly attributed to either episode.

Probability of Future Occurrences:

- Based on historical climatic data, it is clear that the Northern Virginia region will likely continue to experience occasional periods of extreme heat and extreme cold, but not nearly as severe as other regions of the country.

Flood

There are numerous rivers and streams flowing through the Northern Virginia region. When heavy or prolonged rainfall events occur, these rivers and streams are susceptible to some degree of flooding. The most notable of these water bodies is the Potomac River, which in the past has been the source for significant storm surge and tidal flooding[6] – particularly in waterfront communities such as Arlington and Alexandria.

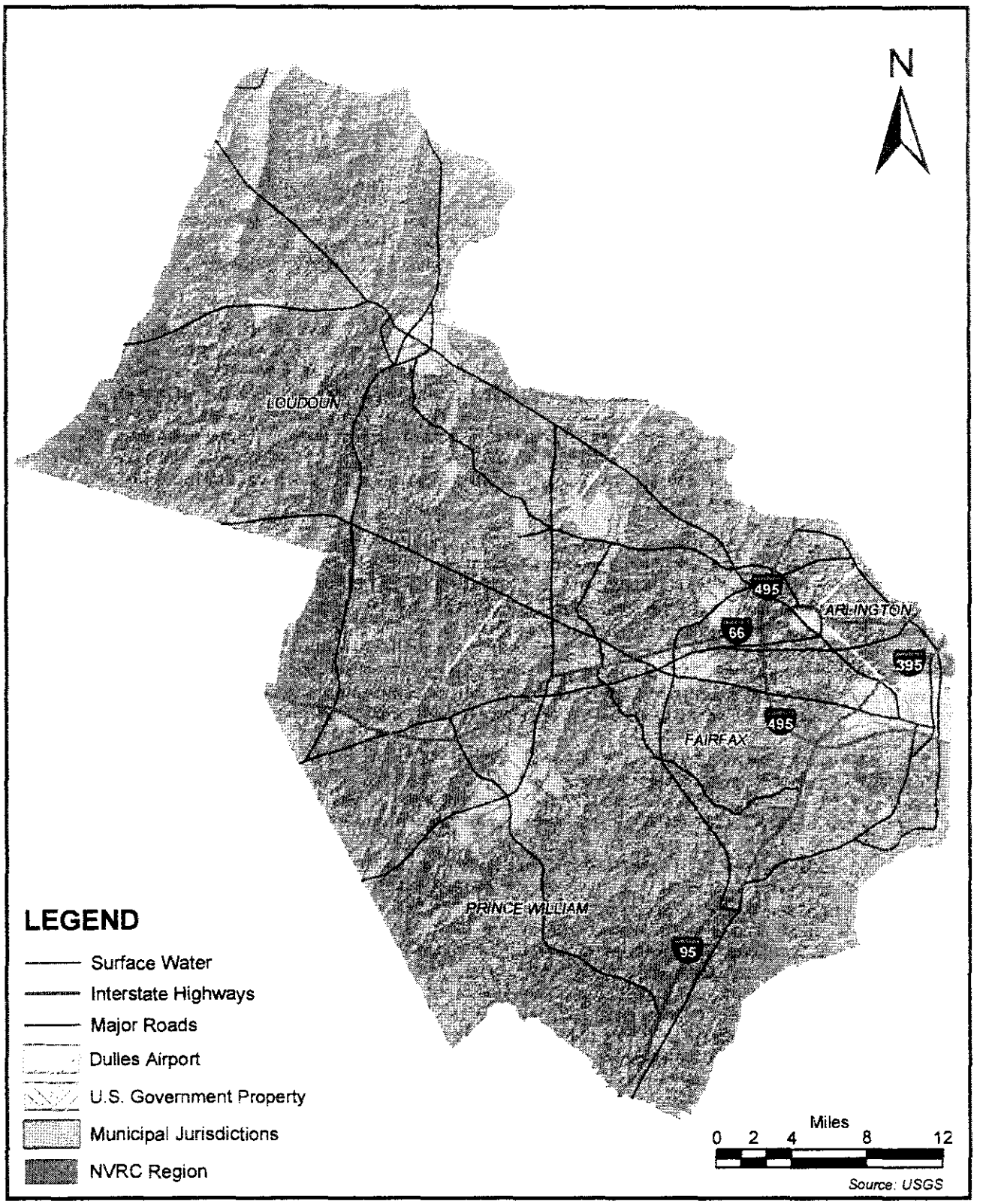
The entire Northern Virginia region falls within the Potomac River Basin, which serves as the border between Maryland and Virginia and flows in a southeasterly direction. The topography of the upper reaches of the basin is characterized by gently sloping hills and valleys. At Great Falls in Fairfax County, the Potomac River starts its rapid descent to sea level by plunging seventy-six feet through a deep gorge in less than one mile. Eastward of Great Falls, the Potomac flows between Washington, DC and Arlington and Alexandria. Here the river dramatically broadens and is flanked by low marshes in many places along the eastern side of Prince William County, where tides further influence the river. The Potomac then continues on through the coastal plain and eventually grows to more than 11 miles wide as it reaches the Chesapeake Bay.

While some of the most dramatic flooding events in Northern Virginia are associated with the tidal flooding of the Potomac River during hurricanes or tropical storms, other typically more frequent inland flood hazards exist throughout the region. Too much rainfall or snowmelt in too little time causes serious flooding problems along even the smallest of tributaries or storm drainage systems. The low-lying areas prone to this type of flooding are known as floodplains or special flood hazard areas. These locations, which are more commonly defined as the "100-year floodplain" (areas with a one percent annual chance of flooding), are routinely surveyed and mapped by FEMA as part of a Flood Insurance Study sponsored by the National Flood Insurance Program (NFIP). These studies and associated maps are then provided to local communities in order to regulate the development of land within these hazard areas.

Figure 5.1 shows the major rivers, streams and water bodies for the Northern Virginia region. **Figure 5.2** shows the potential flood hazard areas throughout the Northern Virginia region based on the best available GIS data for FEMA's identified 100-year floodplains[7]. Where available, more detailed flood hazard data for each jurisdiction within the region is provided in Section 6: Vulnerability Assessment.

There have been a number of past flooding events throughout the region, ranging widely in terms of location, magnitude and impact. The most frequent flooding events are quite localized in nature, resulting from heavy rains in a short period of time over urbanized areas that are not able to appropriately handle stormwater runoff. These events typically do not threaten lives or property and won't result in emergency or disaster declarations, thus historical data is difficult to obtain. **Table 5.4** summarizes the number of flood events (by county) since 1993 which have caused a notable impact on the Northern Virginia region as recorded by the NCDC. This includes 106 flood events that have caused approximately $4.2 million in property damage, as well as one death and one injury. Storm surge and tidal flooding events are not included in Table 5.4, as for purposes of this analysis they are considered separately as an element of the hurricane and tropical storm hazard (see Table 5.6). More detailed information on historical flood events can be obtained through the NCDC Storm Event database as referenced on page three of this section.

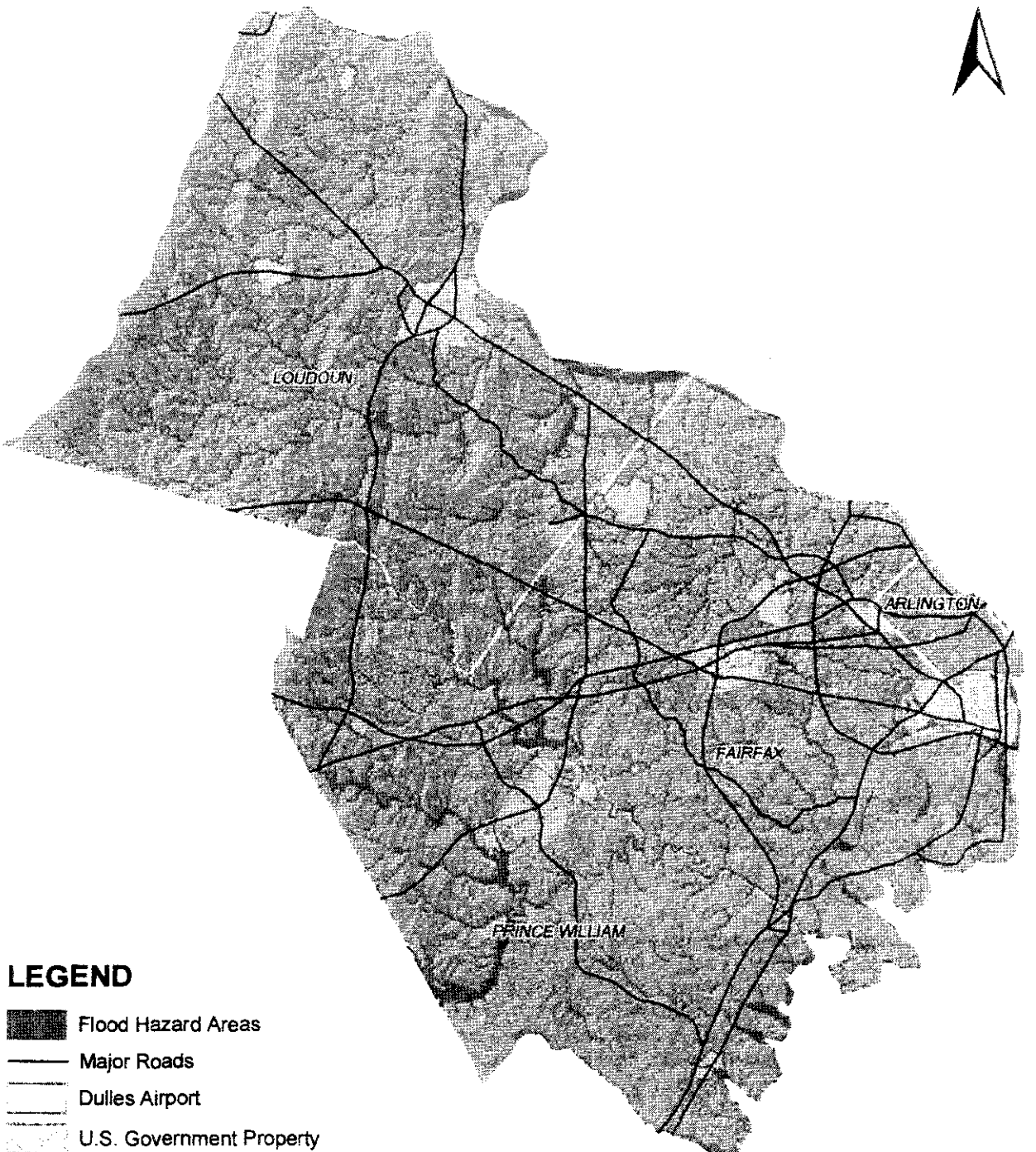
[6] The storm surge and tidal flooding hazard is addressed separately under *Hurricanes and Tropical Storms*.
[7] Digital flood hazard data has not been made available for Arlington or Loudoun counties.



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 5.1

Hydrography



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 5.2

Flood Hazard Areas

Table 5.4
Flood Events in the Northern Virginia Region, 1993–2004

Planning Area	Number of Flood Events	Fatalities	Injuries	Estimated Property Damage
1	12	1	1	$714,000
2	42	0	0	$908,000
3	33	0	0	$2,485,000
4	19	0	0	$84,000
Total	**106**	**1**	**1**	**$4,191,000**

Source: NOAA, National Climatic Data Center

Significant Historical Events:

- September 23, 2003

  Six inches of rain in four hours caused major flooding across the region, but particularly in Loudoun County. During the morning of the 23rd heavy rain fell on top of already saturated ground from Hurricane Isabel which struck a few days before. This led to widespread flooding of roads, waterways, and other low lying areas. Widespread flooding was reported, especially in the Leesburg, Purcellville, Bluemont, Aldie, and Middleburg areas. Across the county, over 50 roads were affected by flooding. Lime Kiln Road, Evergreen Mills Road, and Route 15 were underwater for over 24 hours after Goose Creek surged nearly 11 feet above bankful stage. Little River flooded the Oatlands Mill area and five people had to be rescued from their homes by boat. One farmhouse along Oatlands Mills Road had water up to its second story, and in Aldie the local firehouse sustained significant flood damage and St. Louis Road was completely washed away. In Leesburg, Tuscarora Creek and Town Branch overflowed into yards, basements, and parking lots. Two vans in a parking lot along Town Branch were washed downstream and residents along Shenandoah Street had to be evacuated. The Sheriff's Office administrative building was heavily damaged after the heavy rain collecting on the roof caused the ceiling to collapse. Across the county 60 basements were flooded.

- August 11, 2001

  Showers and thunderstorms with very heavy rainfall and frequent lightning moved across Northern Virginia during the afternoon of the 11th. In Loudoun County, high water stranded motorists in Sterling and the bridge at Lawson Road in Leesburg was impassible after a stream overflowed its banks. Water covered roads in the City of Fairfax. In McLean, four houses were flooded and two cars were submerged by flood waters. Also in McLean, a car and a dumpster were washed downstream after Pimmit Run overflowed. In Arlington County, heavy rainfall washed out a culvert and created a sinkhole. Trees were downed along streams when the waterways overflowed their banks. Flooded roads and downed power lines were reported in North Arlington where a total of 5½ inches of rain was recorded. In Falls Church, more than three inches of rain fell in two to three hours. Red Cross Headquarters was damaged when water flooded a

Street flooding during the flood of August 11, 2001. Flooding occurred along a narrow band from Warrenton, Virginia through Fairfax County, and extended into northern Washington, DC. Up to seven inches of rain fell in some areas. (Photo courtesy of WJLA)

portion of the building. In Prince William County, side roads were flooded by heavy downpours in Manassas. Four homes and two cars were damaged by flood waters.

- January 19–22, 1996

  Snowmelt, combined with one to three inches of rain (some locations received nearly five inches), caused the worst regional flooding in over 10 years. High dew point temperatures melted most of the snow on the ground within 12 hours. The snow pack had a liquid equivalent between two to three inches. River flooding began along the headwaters of all basins and continued downstream through the 22nd, with crests ranging from three to 21 feet above flood stage. High water caused millions of dollars in damage, closed roads, destroyed homes and businesses, and forced the evacuation of several towns. Four people were rescued by the National Park Service and Fairfax County Fire Department at Great Falls when they wandered onto the rocks to view the raging Potomac and became stranded. Several kayakers were also rescued while trying to navigate the rough waters. Flood waters covered Union Street and the lower part of King Street along the river in Old Town Alexandria, and affected Washington National Airport, but not the runways.

- October 11–18, 1942

  Although there is very little data on specific flood impacts, the Northern Virginia region suffered a significant flood event in 1942 following a period of torrential rains that resulted in six to ten inches of water falling across the region. To make matters worse, up to 15 inches fell in areas to the west and upriver. Flood losses on the swollen Potomac River were estimated at $4.5 million, which at the time was deemed the worst river flood to hit the state of Virginia. During this time the Potomac River at Washington, DC reached 17.6 feet (flood stage is seven feet), and areas of Alexandria and Arlington were reportedly seriously flooded.

Floodwaters reach to the steps of the Jefferson Memorial, October 17, 1942. (Photo courtesy of NOAA)

- April 1937

  Just one year after the record flood of March 1936, another major flood struck Virginia. Heavy rains caused widespread flooding over all but southwest Virginia. Flooding on the Potomac was not as bad as the previous year, yet the river reached 14.3 feet at Wisconsin avenue and portions of Alexandria and Arlington again flooded. Total damages to roads and bridges in Virginia came to nearly a half a million dollars. Agricultural losses came to over a million dollars in Northern Virginia alone.

- March 17–18, 1936

  During the period of March 9-22, successive storms crossed the eastern region of the U.S. with floods occurring from Virginia to Maine. In Virginia, the Potomac, Shenandoah, Rappahannock, James, and York Rivers flooded. The winter of 1935-1936 was marked by long-continued periods of low temperatures and heavy snowfalls. In December, it was estimated that areas in the northern Blue Ridge Mountains exceeded 40 inches of snow. Some snow melted during a mild January, but more fell in late January to mid-February. March began with warm temperatures and a thaw. The first rainstorm came in the second week with up to three inches falling. The rains melted the snow, adding an equivalent of one to two inches of rainfall. This caused the rivers to rise and set the stage for the next rain event. The primary flood-producing

rains came March 17 and 18 when a storm, drawing moisture from the Gulf of Mexico, tracked right across Virginia. It dumped an additional six inches of rain on top of the already saturated soil. The Potomac River in Washington, DC rose nine feet above flood stage flooding portions of Arlington and Alexandria including the old airport (where the Pentagon is now located).

Probability of Future Occurrences:

- Flooding remains a highly likely occurrence throughout the identified flood hazard areas of the Northern Virginia region. Smaller floods caused by heavy rains and inadequate drainage capacity in urbanized areas will be more frequent, but not as costly as the large-scale floods which may occur at much less frequent intervals.

Hurricanes and Tropical Storms

Although the Northern Virginia region rarely experiences the wrath of a direct landfalling hurricane, it is located in an area quite susceptible to the remnants of such storms. This includes the perils of hurricane and tropical storm force winds, heavy rains and significant storm surge and tidal flooding. These events can be extremely dangerous and costly to areas across a large geographic area, as was recently learned during Hurricane Isabel in 2003 when the region suffered approximately $32 million in damages ($1.6 billion statewide).

The majority of hurricanes and tropical storms that have affected Virginia have originated in the Atlantic Ocean. Since 1851, there have been a total of 28 storms to come within 75 miles of the Northern Virginia region (other notable storms, including hurricanes Floyd (1999), Fran (1996) and Agnes (1972) are discussed herein but were beyond the 75 mile radius used for this analysis[8]). Five of these storms were classified as hurricanes (including Isabel in 2003), and 23 as tropical storms. These events are listed in **Table 5.5**.

Table 5.5
Historical Hurricane and Tropical Storm Events in the Northern Virginia Region, 1851–2004

Year	Month	Name	Wind Speed (MPH)	Intensity
1872	October	Not named	45	Tropical Storm
1874	September	Not named	60	Tropical Storm
1876	September	Not named	80	Category 1
1878	October	"Gale of '78"	105	Category 2
1882	September	Not named	45	Tropical Storm
1883	September	Not named	45	Tropical Storm
1888	September	Not named	50	Tropical Storm
1888	September	Not named	40	Tropical Storm
1893	August	Not named	70	Tropical Storm
1893	October	Not named	90	Category 1
1893	October	Not named	50	Tropical Storm
1896	September	Not named	60	Category 1
1899	October	Not named	65	Tropical Storm
1904	September	Not named	65	Tropical Storm
1928	September	Not named	45	Tropical Storm
1933	August	Not named	60	Tropical Storm
1943	October	Not named	40	Tropical Storm
1944	August	Not named	50	Tropical Storm
1945	September	Not named	40	Tropical Storm
1949	August	Not named	45	Tropical Storm
1952	September	Able	45	Tropical Storm
1955	August	Connie	60	Tropical Storm
1955	August	Diane	65	Tropical Storm
1979	September	David	45	Tropical Storm
1983	September	Dean	45	Tropical Storm
1992	September	Danielle	45	Tropical Storm
1996	July	Bertha	70	Tropical Storm
2003	September	Isabel	75	Category 1

[8] A chosen distance of 75 miles was used for this analysis in order to focus on those storms that came through areas closest to the Northern Virginia region. However, the effects of large hurricanes and tropical storms may be felt up to 200 miles away from the center of circulation.

The individual tracks for those storms listed in Table 5.5 are shown in **Figure 5.3**. Of these, seven storm tracks made direct paths through the region. This includes the "Gale of '78," a category 2 hurricane which is further described under *Significant Historical Events*. An additional 25 storm tracks for tropical depressions and extratropical systems came within 75 miles of the region, but these are not included in the figure.

Although some good narrative information has been gathered on the impacts of these events (see *Significant Historical Events*), data on estimated property damages could only be accessed through the NCDC for the last 10 years. **Table 5.6** summarizes estimated damage figures caused by hurricane and tropical storm events by planning area since 1993 as recorded by the NCDC. These events have amounted to more than $45 million in property damages, most of which is attributable to effects of storm surge and tidal flooding resulting from the storms. More detailed information on historical hurricane and tropical storm events can be obtained through the NCDC Storm Event database as referenced on page three of this section.

Table 5.6
Historical Hurricane and Tropical Storm Damages in the Northern Virginia Region, 1993–2004

Planning Area	Estimated Property Damage
1	$13,297,000
2	$18,044,000
3	$3,817,000
4	$9,890,000
Total	**$45,048,000**

Source: NOAA, National Climatic Data Center

Significant Historical Events:

- September 18–19, 2003 (Isabel)

  Hurricane Isabel made landfall on the North Carolina Coast. Its huge wind field was already piling water up into the southern Chesapeake Bay. By the time Isabel moved into central Virginia, it had weakened and was downgraded to a tropical storm. Isabel's eye tracked well west of the bay, but the storm's 40 to 60 mile per hour sustained winds pushed a bulge of water northward up the bay and its tributaries producing a record storm surge. The Virginia western shore counties of the Chesapeake Bay and the tidal tributaries of the Potomac, Rappahannock and other smaller rivers, experienced a storm surge which reached 5 to 9 feet above normal tides.

  In Alexandria, the water level in Old Town reached 9.5 feet above sea level. Numerous businesses were flooded and the marinas were hard hit. Winds also knocked trees down around the city. Damages totaled $2 million. Storm surge water flooded the employee parking lot of Ronald Reagan Washington National Airport. Arlington had two homes destroyed and 46 with major damage, while another 146 residences had minor damage. Costs of flooding and damage from falling trees were estimated at $2.5 million. In Fairfax County, 160 homes and 60 condominiums were flooded in the Belleview area south of Alexandria. Over 2,000 units had minor to moderate damage from storm surge flooding. In addition, many trees fell causing additional property damage across the county. In the City of Fairfax, 15 homes had major damage from trees. Fairfax County damages came to $18 million. In Prince William County, seven homes were destroyed and 24 homes and three businesses had major damage. Scattered trees and wires were down causing roads to be closed. The storm surge washed away 20 feet of

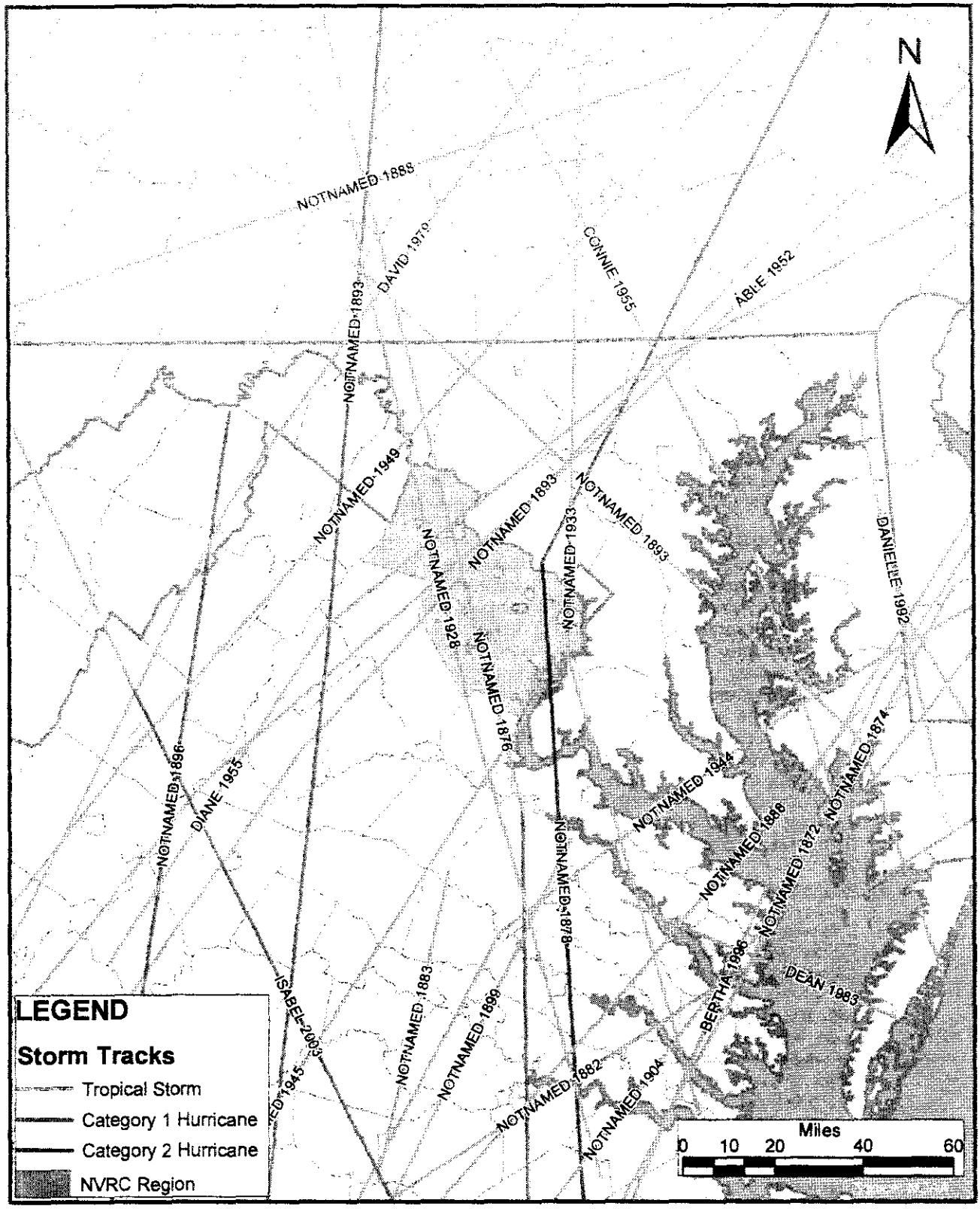


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Figure 5.3

Historical Hurricane and Tropical Storm Tracks, 1851-2004

embankment along the Potomac which caused one of the CSX tracks to collapse along the Cherry Hill Peninsula. Damages at Quantico Marine Base were significant. Quantico's weather station recorded a two minute sustained wind of 54 miles per hour with a peak gust of 78 miles per hour between 11 pm and Midnight on the 18th. Damages to the base included buildings, houses and vehicles hit by fallen trees and flooding destroyed their marina. Total damages were reported to be $9.5 million.

- September 16, 1999 (Floyd)

Hurricane Floyd made landfall just east of Cape Fear, North Carolina in the early morning hours of the 16th and moved north-northeast across extreme southeast Virginia to near Ocean City, Maryland by evening on the 16th. Rainbands on the outer edge of the hurricane began to affect Northern Virginia shortly after 8:00 AM on the 15th and continued to cross the area through afternoon on the 16th. Gusty winds of 30 to 50 miles per hour blew north and east of a line from Spotsylvania County to Frederick County between 11:00 AM and midnight on the 16th. Hundreds of trees were downed from the combination of very heavy rain and strong winds. A total of two to five inches of rain fell in this area and 16,000 power outages were reported.

In Prince William County, 17 trees came down on roads and power lines, and two homes were slightly damaged by fallen trees. In the Montclair area, 1,000 residents lost power. Some secondary roads were also flooded. A few trees were downed in the Manassas area. In Fairfax County, a 61 year old woman was killed when a tree fell onto her car and crushed it on Fair Lakes Drive. One business was destroyed by fallen trees and another in Falls Church was damaged. A 70-foot oak tree fell onto a home and tore a hole in the 2nd floor, shattering windows and tearing off rain gutters. The tree also damaged a detached garage and a swingset. The Mason Neck area saw several large trees downed, including a 100-foot poplar that put a hole through a bedroom of a two story home. Mt. Vernon and Vienna also reported several downed trees, including one which damaged a car. The County had to hire 16 tree trimming contractors to clear downed trees that blocked roadways. Flooding caused problems at seven major intersections and on 20 secondary roads. Winds and rain combined to topple 130 trees in Arlington County and Alexandria. One tree damaged a home and 4,500 power outages were reported. In Loudoun County, a handful of trees were downed and a road was blocked near Mt. Weather. Siding was also torn from a few homes.

- September 5, 1999 (Dennis)

The remnants of Hurricane Dennis moved across the northern half of Virginia from midday on the 4th through midday on the 6th. Its legacy included very heavy rain and wind gusts in excess of 45 miles per hour. The heaviest period of rain in the region occurred between 3:00 AM and 8:00 AM on the 5th. The City of Alexandria along the tidal Potomac River reported minor problems with flooding. The storm surge from Hurricane Dennis along with persistent southeast winds made tide levels two to three feet above normal on the 5th and 6th. At high tide, portions of the city near the waterfront were invaded by water which subsided again with each low tide. The 100 block of King and Union Streets was flooded for a time on Sunday. River levels reached as high at 6.5 feet at the Wisconsin Avenue gauge during the early morning and late afternoon both days.

- September 6, 1996 (Fran)

The rapid runoff produced by the heavy rains from Hurricane Fran caused substantial, damaging, and in some cases record river flooding across much of the Northern Virginia watershed from late on the 6th until early on the 10th. Flash flooding on the 6th rapidly became river flooding late on the 6th along the headwaters of the Potomac, Shenandoah, and Rappahannock River basins, and continued throughout the basins over the weekend and into early the following week. Crests

at gauging points in these basins were similar to those in January 1996 across the Lower Main Stem of the Potomac. Levels were one to five feet higher across the Upper Main Stem Potomac and Rappahannock Rivers. The Shenandoah Basin had levels similar to the October 1942 flood with three points reaching record levels (Lynnwood, Cootes Store, and Strasburg). There were numerous road closures, rescues, evacuations, washed out and damaged bridges and culverts; the flood also produced major agricultural damage. Debris covered pasture and farmland, and filled small creeks and streams to levels higher than surrounding roads, which redirected the natural stream flow. River sand and mud covered streets and multiple levels of homes and businesses. There were several electric and phone outages. Three deaths occurred in the northern half of Virginia due to flash flooding.

The Old Town section of Alexandria also saw extensive tidal flooding from the Potomac River. Water was 5 feet deep in the lower portion of the city and many shops were flooded, some losing merchandise. Heavy rains and wind driven water exacerbated the tidal flooding problem. The wind driven storm surge reached over five feet above normal and came at about the same time as high tide which was 4:11 PM at the Wisconsin Avenue gage in Washington, DC. Because of Alexandria's orientation to the wind, water levels were likely a little higher. Washington National Airport in southern Arlington County also had damage with the river crest late Sunday into Monday morning. Flooding tore out their security fence and flooded their boat houses where their rescue equipment is kept, while mud and debris had to be removed from the grounds.

- September 5, 1979 (David)

  Hurricane David spawned eight tornadoes across Virginia. Two cities and five counties were hit from Norfolk in the southeast to Leesburg in the north. Because the tornadoes were associated with the spiral bands of a hurricane, they moved from the southeast to the northwest. In total there was one death and 19 injuries caused by the storm. Fairfax County had $2.5 million in damages.

- June 1972 (Agnes)

  Hurricane Agnes, in its tropical storm stage, caused torrential rains over Virginia and the Mid-Atlantic States. All rivers in Virginia were affected. Ten inches of rain fell over Northern Virginia resulting in widespread flash flooding and major flooding on the Potomac River. Lake Barcroft Dam in Fairfax County failed but resulted in no loss of life.

- August 31, 1952 (Able)

  The first hurricane of the season made landfall between Charleston and Savannah and moved north across Virginia and Washington, DC in a very weakened form. Rainfall was around two to three inches. It produced winds of 30 to 40 miles per hour with peak gusts to 60 miles per hour. Its greatest impact on Virginia was a small tornado (F2) that struck Franconia in Fairfax County. It traveled two miles and was around 100 yards wide. Property damage in the area was $500,000 caused by flooding, the tornado, and falling trees and branches that disrupted power and telephone facilities.

- October 22-23, 1878 (Gale of '78)

  The hurricane's eye made landfall at Cape Fear, NC and moved north across Richmond and Washington, DC and seemed to lose little strength. The storm was thought to resemble that of Hurricane Hazel in 1954. Winds downed trees and fences and unroofed homes, and very high tides occurred on the coast. Fields of corn were submerged in the ensuing flood around Washington, DC. Rock Creek became a raging river, but produced little damage. Many young

shade trees in the area were leveled. Telegraph lines fell between Baltimore and New York. Flooding from the Potomac inundated many basements and county roads crossing the Stickfoot branch of the Anacostia River were washed out.

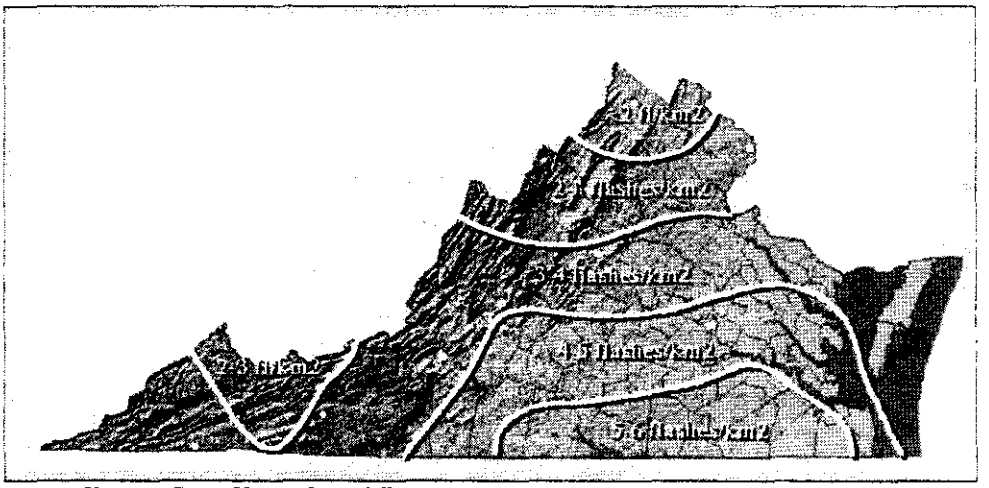
Probability of Future Occurrences:

- The Northern Virginia region will not likely experience the effects of a major (Category 3 or stronger) hurricane, however the region remains susceptible to the effects from such storms making landfall along the Atlantic coast of the United States. According to FEMA's HAZUS^{MH} software, the Northern Virginia region should expect to see hurricane force winds (with peak gust wind speeds of up to 89 miles per hour) at least once every 50 years. The effects of tropical storms (sustained wind speeds of at least 39 miles per hour and torrential rains) will be more frequent, particularly from those storms making landfall further south and proceeding up the Atlantic seaboard.

Severe Thunderstorms

Thunderstorms are common throughout the state of Virginia, and have been known to occur during all calendar months. In addition to the high winds associated with these events, thunderstorms can also bring dangerous lightning that can cause fires, property damage and may cause death or serious injury to humans. **Figure 5.4** shows lightning strike densities (also an indicator for thunderstorm intensity) for the state of Virginia as recorded for the year 1989, which indicates the Northern Virginia region experiences less strike density than other areas of the state.

Figure 5.4
Virginia Lightning Strike Density Map



Source: Virginia State Climatology Office

A thunderstorm with wind gusts in excess of 58 miles per hour (50 knots) and/or hail with a diameter of 3/4" or more is classified as a "severe thunderstorm." Hail is another element of this form of inclement weather, and can cause varying degrees of property and crop damage. **Table 5.7** provides summary information on historical thunderstorms, lighting and hail events that have occurred in the Northern Virginia region since 1955, as recorded by the NCDC. These events have reportedly caused three deaths and 33 injuries, and have amounted to approximately $55 million in property damages in the past five decades (these figures include damages caused by the effects of wind, hail, lightning and heavy rains). More detailed information on thunderstorm and high wind events can be obtained through the NCDC Storm Event database as referenced on page three of this section.

Table 5.7
Thunderstorm Events in the Northern Virginia Region, 1955–2004

Planning Area	Number of Thunderstorm Events	Fatalities	Injuries	Estimated Property Damage
1	86	0	3	$920,000
2	394	2	11	$38,713,000
3	270	0	11	$10,594,000
4	159	1	8	$4,486,000
Total	**909**	**3**	**33**	**$54,713,000**

Source: NOAA, National Climatic Data Center

Significant Historical Events:

- August 3, 2002

  Numerous thunderstorms with high winds, large hail, frequent lightning, and heavy downpours moved through the region during afternoon and evening hours. In Fairfax, a spotter reported a wind gust in excess of 50 miles per hour. In Prince William County, nearly 2 million dollars in damage was reported in the Manassas area (a wind gust of 67 miles per hour was recorded at the Manassas Airport). The high winds downed numerous trees in Manassas and Manassas Park. In addition, dime to quarter sized hail fell in Manassas and Manassas Park for over 20 minutes, resulting in extensive roof, siding, and vehicle damage. Very heavy downpours also caused minor flooding on streets. An observer in Manassas Park reported a total of 5¼ inches of rainfall in only 90 minutes.

- August 7, 2000

  Scattered thunderstorms developed across northeast Virginia during the hot and humid afternoon and evening hours, causing nearly hundreds of trees to be downed onto homes, roads, cars, and power lines across the region. These thunderstorms produced winds in excess of 55 miles per hour, large hail, frequent lightning, and heavy rainfall. Over 70,000 customers lost power across Northern Virginia as a direct result of the storms.

- April 23, 1999

  A line of thunderstorms developed in West Virginia during the early afternoon and moved rapidly southeast across Northern Virginia. These storms produced high winds and very large hail across the region, causing significant damage to cars and structures. Loudoun County bore the brunt of the storm, where up to baseball-sized hail broke store windows and damaged several vehicles in Middleburg. Prince William County suffered damage from hail between 1 and 1¾ inches in diameter, resulting in damage to cars, roofs, and siding. Much of Fairfax County also received significant damage, with hail up to 2¾ inches in diameter. Reportedly hundreds of cars were dented, several windows and skylights were broken, trees and bushes were stripped of their leaves, siding and shutters were damaged, and roof shingles were chipped.

- September 6, 1996

  Gusty winds in excess of 40 miles per hour, combined with soft soil from previous rainfall, caused scattered tree damage across much of the region. In Fairfax County, a motorist died when his car slammed into a fallen tree. Tree damage was also noted in Arlington and Prince William County. Virginia Power estimated 38,300 customers without power in Northern Virginia mainly due to the high winds; however, there were likely more than 50,000 customers without power after accounting for rural electric cooperatives.

- October 21, 1995

  A cold front which produced flash flooding during the late evening of the 20th induced thunderstorms east of the mountains. One lightning strike hit a fast food restaurant in Fairfax County, setting it ablaze and destroying it. Damage was estimated to be at least $300,000.

- April 12, 1994

  Lightning started several house fires in Fairfax County. One house fire caused $400,000 in damage, while another one caused $200,000 damage.

- July 20, 1975

  Sixteen people were struck and injured by a lightning strike while picnicking in Annandale (Fairfax County).

Probability of Future Occurrences:

- Severe thunderstorms will remain a highly likely occurrence for the Northern Virginia region.

Tornadoes

When compared with other states, Virginia ranks 29th in the nation in number of tornado events, 25th in tornado deaths, 26th in tornado injuries, and 28th in damages. These rankings are based upon data collected for all states and territories for tornado events between 1950 and 1994 by NOAA's Storm Prediction Center. Most tornadoes that occur in Virginia are less intense (F0 through F2 on the Fujita-Pearson Scale[9]) than those that occur elsewhere in the country, but occasionally they are of significant magnitude causing major damage and destruction.

From 1950 through the year 2001, 376 tornadoes were documented in Virginia (an average of seven tornadoes per year). Nationally, statistics have suggested that prior to 1990, only a third of all tornadoes were actually recorded. Many occurred in unpopulated areas or caused little property damage and therefore are not reported to NOAA's National Weather Service, while others may have been recorded separately as high wind events instead of tornadoes. Thus, the actual average number of tornadoes that Virginia experiences in a given year is likely higher than historical NOAA records indicate. Tornado fatality records began in 1916, and since then only 65 people have been known to have died from tornadoes in Virginia. A third of these deaths occurred during a tornado outbreak on May 2, 1929, Virginia's worst tornado outbreak.

According to NCDC records, the Northern Virginia region experienced 39 tornado events from 1950 through 2004. The geographic locations for 31 of these 39 historical tornado locations are shown in **Figure 5.5**, based upon the coordinates recorded by the NCDC for the beginning location of the tornado occurrence. As can be seen in the figure, most of these events have been recorded as either F0 or F1 events although there have also been some stronger F2 and F3 events.

In total, these tornado events are reported to have caused two deaths, 58 injuries and approximately $40 million in property damages as summarized by planning area in **Table 5.8**. Another seven funnel cloud events were recorded during this time period, although no damages are associated with these systems since the cloud system does not physically touchdown on the ground. More detailed information on each these historical tornado events can be obtained through the NCDC Storm Event database as referenced on page three of this section.

Table 5.8
Tornado Events in the Northern Virginia Region, 1955–2004

Planning Area	Number of Tornado Events	Fatalities	Injuries	Estimated Property Damage
1	2	0	2	$1,100,000
2	14	1	44	$34,355,000
3	18	0	2	$1,523,000
4	5	1	10	$2,762,000
Total	**39**	**2**	**58**	**$39,740,000**

Source: NOAA, National Climatic Data Center

[9] The Fujita-Pearson Scale for Tornadoes may be found in Section 4: Hazard Identification (Table 4.5).

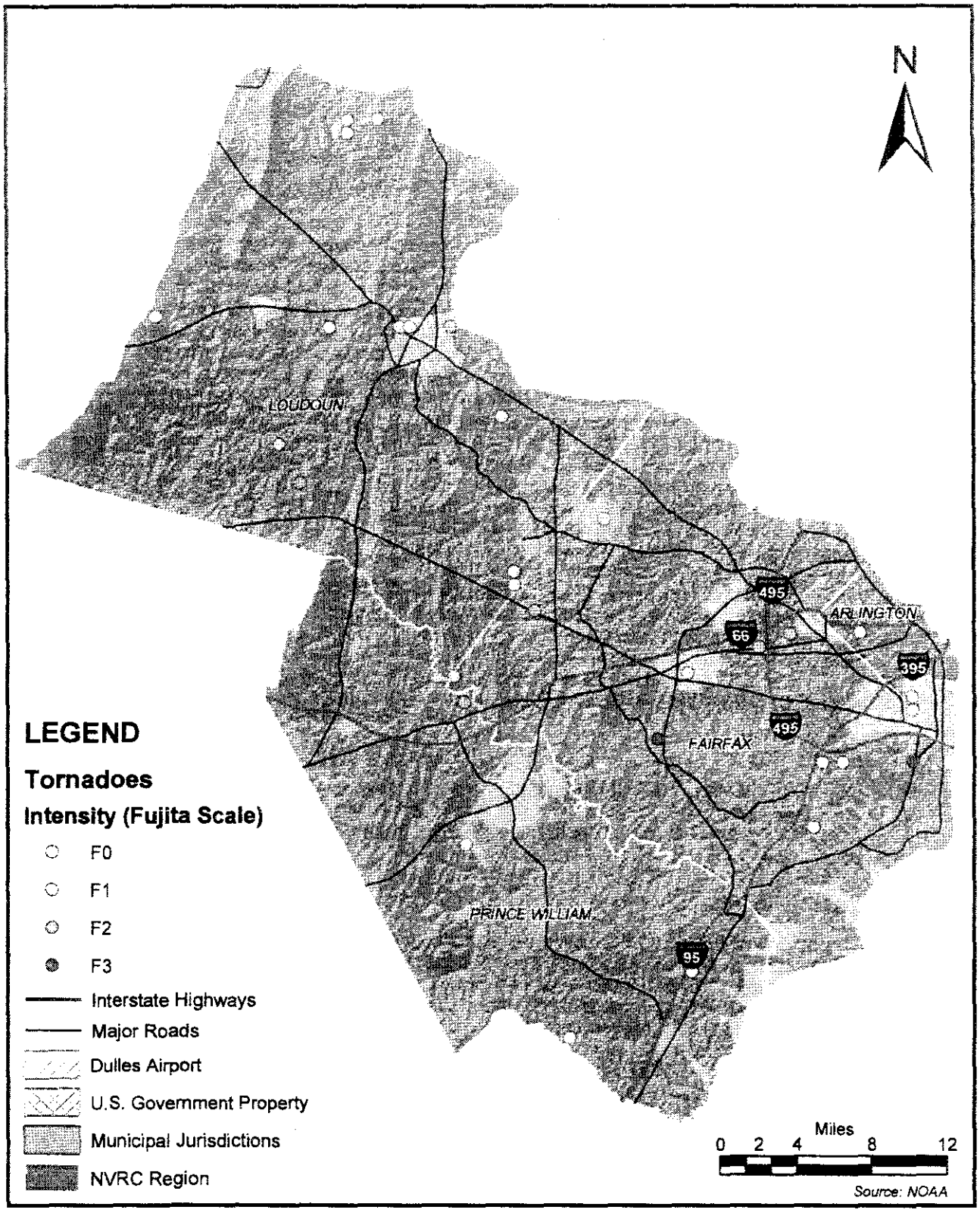


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Figure 5.5

Historical Tornadoes, 1950-2004

Significant Historical Events:

- September 24, 2001

Five tornadoes touched down in Northern Virginia during the afternoon and early evening of the 24th. One of these touched down in Prince William County where it downed some trees in Prince William Forest Park area. The tornado moved north into the Lake Montclair community where it took down a few trees, broke branches, and bent siding up on homes. The weak tornado lifted shortly after. A second tornado which remained on the ground for 15 miles passed through densely populated areas of Eastern Fairfax County, the western portion of the City of Alexandria, and Arlington County causing minor injuries and significant damage to trees, residences and businesses. Its strength varied between F0 and F1 as it crossed the Interstates three times during rush hour traffic. Cars were hit with flying debris and some windows were blown out. Hundreds of homes and numerous parked vehicles were also damaged. Most of the damage was minor to the exterior and roofs of homes. A few homes suffered more significant damage, mainly in Shirlington area of Arlington County. Total damages were estimated at around $1 million. Only two people are known to have been injured. Before the tornado moved into Washington DC, it passed right by the Pentagon City Mall and the Pentagon itself. Numerous recovery workers at the Pentagon in the aftermath of the 9-11 attack had to take cover from the tornado in underground tunnels.

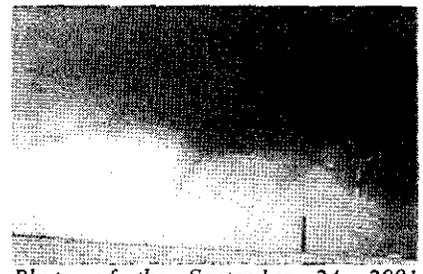

Photo of the September 24, 2001 tornado as it entered Washington DC. The Washington Monument can be seen to the left of the U.S. Flag pole. (Photo courtesy of Michael Shore)

- May 25, 1997

A small, brief tornado, packing winds up to 70 miles per hour, knocked down between 75 and 100 trees and limbs, some of which fell onto residences, vehicles, and other property in South Arlington. Scattered structural damage included aluminum siding, gutters, shingles, and plastic facia.

- June 24, 1996

A tornado, associated with the mesocyclone of a heavy-precipitation supercell, touched down in extreme southeastern Loudoun County near the Bull Run, then proceeded east-southeast for 20 miles knocking down over 1000 trees and causing substantial property damage, especially in western Fairfax County, before lifting along the Capital Beltway at the Braddock Road interchange less than 2 miles west of Annandale. The most significant damage occurred along Tree Line Drive, where 11 of 17 homes incurred moderate to major damage. The combined efforts of several agencies produced property damage estimates along the track (not including flora) to be $2.9 million. Included in that total are 323 homes which sustained minor damage. An estimated 80 thousand homes lost power along the track of the tornado in Fairfax County, with some homes not receiving power until several days after the event.

- April 16, 1993

A tornado touched down approximately a ½ mile southwest of Saint Louis in the southern part of Loudoun County, and moved east northeast for about 1.7 miles. The storm knocked down and damaged hundreds of trees. Roofs of two barns were blown off, windows were blown out and fences were ripped up.

- October 13, 1983

  A strong F2 tornado touched down in Fairfax and moved seven miles into Falls Church and McLean, heavily damaging many homes and overturning cars and trucks.

- September 5, 1979

  Hurricane David spawned six tornadoes across Virginia. A strong F3 tornado struck Fairfax County tracking 18 miles, killing one and injuring six people. It struck the same school hit by a tornado on April 1, 1973, this time causing $150,000 damage. Numerous cars were demolished, 90 homes damaged, and trees and debris blocked roads. Damages in Fairfax County reached $2.5 million dollars. An F2 tornado struck the Sugarland Run Subdivision of Sterling in Loudoun County, injuring 2 people and damaging 80 homes. Four homes were unroofed or seriously damaged. Damages were estimated at $250,000.

- April 1, 1973

  A strong F3 tornado struck a populated area of Northern Virginia. It touched down in Prince William County and traveled 15 miles northeast through Fairfax and into Falls Church. Extensive damage occurred along a six mile stretch in Fairfax. A high school, two shopping centers, an apartment complex, and 226 homes were damaged. Only 37 people were injured. It could have been much worse, but it was Sunday and "Blue Laws" were still in effect--the normally busy shopping center which had extensive damage was closed and school was not in session. Damage totaled an estimated $14 million.

- May 2, 1929

  On a day known as "Virginia's Deadliest Tornado Outbreak," the town of Hamilton in Loudoun County (six miles northwest of Leesburg) experienced one of the five tornadoes causing widespread destruction across the state. The tornado path was reportedly 200 yards across and two miles long. It destroyed a house, barn and some smaller buildings at one farm. It caused several injuries but no deaths. Other nearby farms were damaged as well as a brick church.

- November 17, 1927

  A tornado touched down in a rural part of Fairfax County and moved northeast across the western part of Alexandria, then across the Potomac River and Washington, DC into Maryland. Over 100 people were injured in Alexandria and over 200 homes were unroofed and torn apart.

Probability of Future Occurrences:

- It is likely that the Northern Virginia region will continue to experience weak to moderately intense tornadoes. It is unlikely that very strong tornadoes (F4 or F5) will strike the area, though it does remain possible.

Wildfire

While the state of Virginia rarely experiences the large, extensive wildfires typically seen in the western regions of the United States, wildfire risk remains a genuine concern. According to the Virginia Department of Forestry (VDOF), about 1,600 wildfires consume a total of 8,000 to 10,000 acres of forest and grassland in the state each year. During the fall drought of 2001, Virginia lost more than 13,000 acres to wildfires.

Virginia's wildfire season normally occurs in the spring (March and April) and then again in the fall (October and November). During these times, the relative humidity is usually lower, winds tend to be higher, and the fuels are cured to the point where they readily ignite. Also during these times hardwood leaves are on the ground providing more fuel and allowing sunlight to directly reach the forest floor, warming and drying the surface fuels.

Fire activity fluctuates during each month and also varies from year to year based on precipitation amounts. During years of adequate rain and snow, wildfire occurrence is typically low. Lack of moisture during other years means extended periods of warm, dry, windy, days and therefore increased fire activity. The damage caused by Hurricane Isabel in 2003 has increased the threat of wildfires in Virginia, and will be a major threat to lives and homes in the eastern half of Virginia for several years to come. The dead and downed timber caused by the storm has had time to cure and could produce wildfires that will be larger and much harder and dangerous to suppress.

Records indicate that most of Virginia's wildfires are caused by people. Virginia is growing more rapidly than many other states, and its population has doubled in the last 45 years. Further, people are moving into residential developments located within forested areas, and there is an increased use of the forests for recreational uses. All of these trends increase the risk of wildfires and requires continued fire prevention and protection activities.

The Northern Virginia region is not considered as at-risk to wildfire as other areas of the state, but wildfire occurrence is certainly prevalent – particularly in Loudoun and Prince William counties. According to VDOF records, there were 86 wildfire events in the Northern Virginia region between 1995 and 2001. These fires burned a total of 336 acres and caused an estimated $176,000 in property damages, but fortunately caused no deaths or injuries. These fires were typically small in size, burning an average of approximately four acres before being suppressed (an estimated $7.5 million in damages was prevented by fire control efforts during this period). Of the 86 recorded historical incidents during this period, only six fires burned an area greater than 10 acres (all in Loudoun County). **Table 5.9** lists the number of these fire events, acres burned and estimated property damages by planning area for the Northern Virginia region. The location these historical wildfire occurrences are shown in **Figure 5.6**.

Table 5.9
Wildfire Events in the Northern Virginia Region, 1995-2001

Planning Area	Number of Wildfire Events	Acres Burned	Estimated Property Damage
1	0	0	$0
2	1	3.0	$0
3	65	271.8	$160,400
4	20	64.3	$15,100
Total	**86**	**339.1**	**$175,500**

Source: VDOF

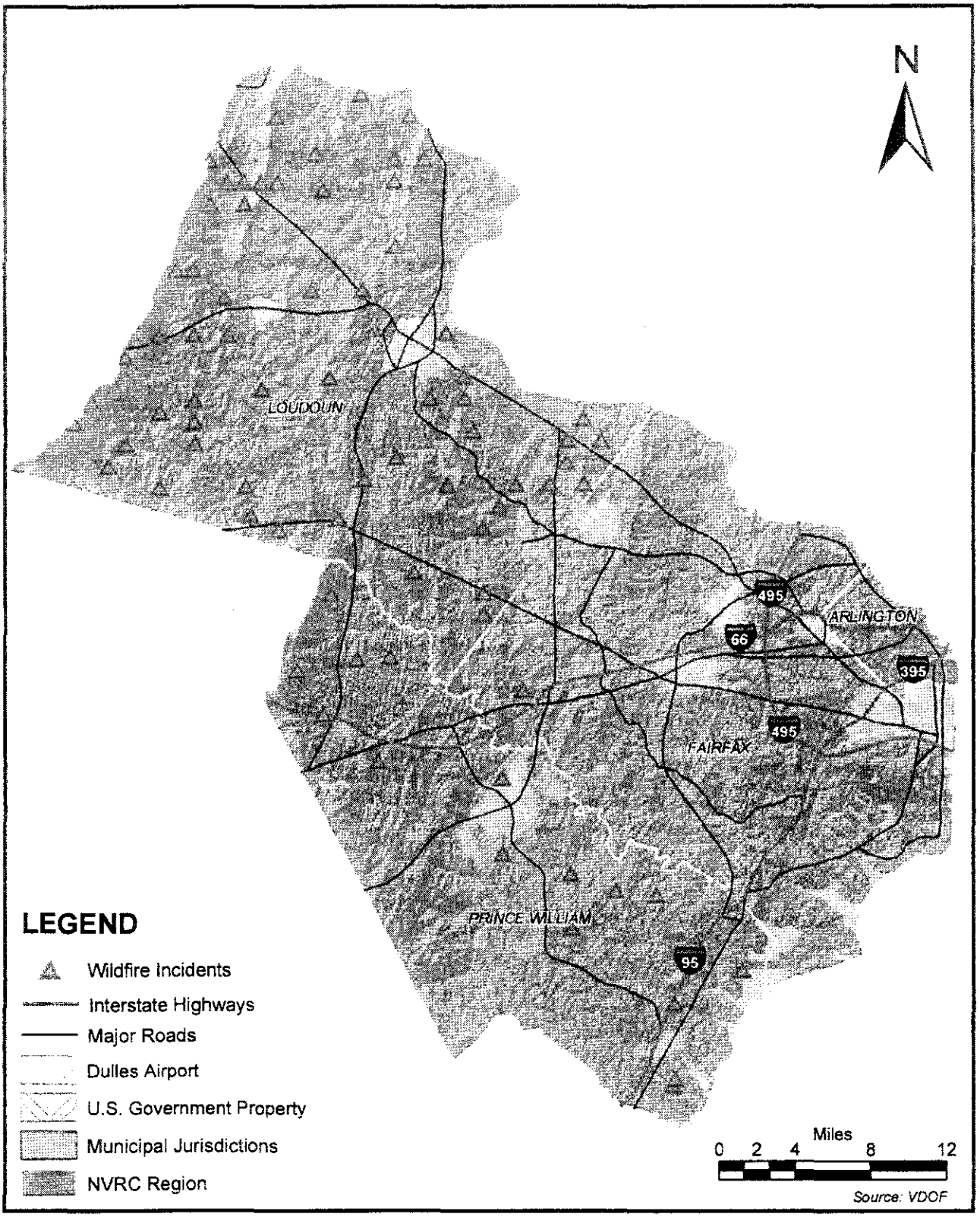

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Figure 5.6

Historical Wildfires, 1995-2001

The majority of the wildfire occurrences listed in Table 5.9 was caused by debris burning and other human activities. **Table 5.10** shows the leading causes of wildfires in the Northern Virginia region based on VDOF records for the 86 historical wildfires occurring between 1995 and 2001.

Table 5.10
Leading Causes of Wildfires in the Northern Virginia Region

Cause	Percent of Wildfire Events
Debris Burning	29%
Children	23%
Incendiary	16%
Smoking	14%
Miscellaneous	8%
Equipment Use	6%
Campfire	2%
Railroad	1%
Lightning	0%

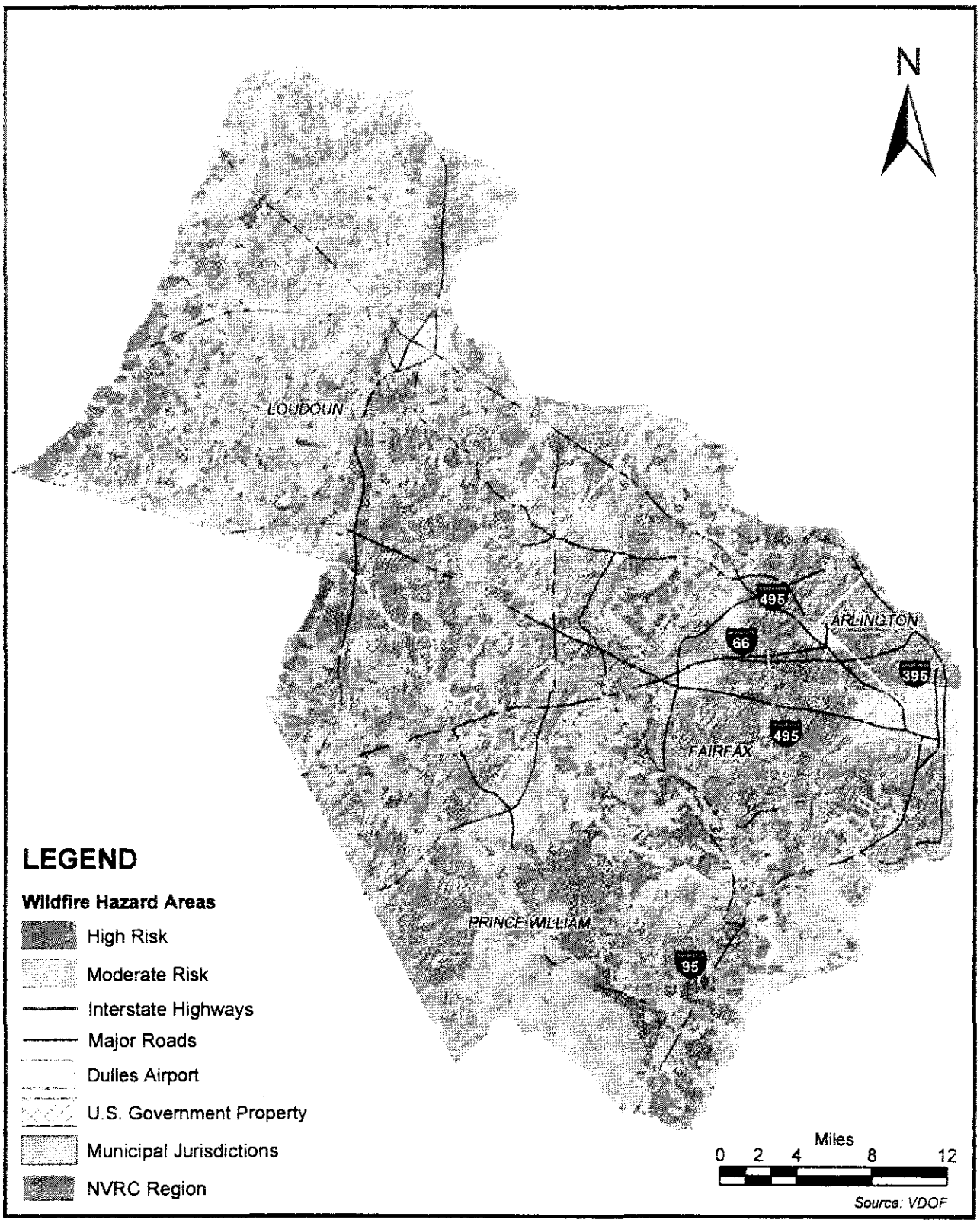
Source: VDOF

In 2003, VDOF used GIS to develop a statewide spatial *Wildfire Risk Assessment* model that aims to: (1) identify areas where conditions are more conducive and favorable to wildfire occurrence and wildfire advancement; (2) identify areas that require closer scrutiny at larger scales; and (3) examine the spatial relationships between areas of relatively high risk and other geographic features of concern such as woodland home communities, fire stations and fire hydrants. This model incorporates data from several other state and federal agencies including land cover, demographics, transportation corridors and topography to illustrate the level of wildfire risk for all areas across the state of Virginia. **Figure 5.7** shows the results of using the VDOF model to map wildfire hazard areas for the Northern Virginia region[10]. As can be seen in the figure, most wildfire hazard areas are located in Loudoun and Prince William counties.

Probability of Future Occurrences:

- Wildfires remain a highly likely occurrence for Loudoun and Prince William counties, though most will likely continue be small in size before being contained and suppressed.

[10] More information on VDOF's GIS-based Wildfire Risk Assessment is available at www.dof.virginia.gov.



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 5.7

Wildfire Hazard Areas

Winter Storms

The Northern Virginia region is located in a part of the country that frequently experiences hazardous winter weather conditions, including severe winter storms that bring heavy accumulations of snow, sleet, freezing rain and ice. On average, the NCRV region receives approximately 17 inches of snow per year. Virginia's biggest winter storms are typically associated with nor'easters (described in Section 4: Hazard Identification under *Hurricanes and Tropical Storms*). During these events, winds around the storm's center can become intense, building waves that rack the Potomac coastline and sometimes pile water inland causing extensive coastal flooding and severe beach erosion. Other types of winter weather systems generally do not cause major problems for Virginia. Storms such as the "Alberta Clipper" (a fast moving storm from the Alberta, Canada region), or a cold front sweeping through from the west, generally do not bring more than four inches of snow in a narrow 50 to 60 mile-wide band.

Since 1993, there have been 197 instances of winter storms recorded by the NCDC for the Northern Virginia region causing an estimated $1.2 million in property damage as summarized by planning area in **Table 5.11**. Most storm damages are attributable to traffic accidents and roof collapses. No deaths or injuries have been attributed by NCDC to these storm events. More detailed information on these historical winter storm events can be obtained through the NCDC Storm Event database as referenced on page three of this section.

Table 5.11
Winter Storm Events in the Northern Virginia Region, 1993–2004

Planning Area	Number of Winter Storm Events	Estimated Property Damage
1	41	$306,200
2	50	$307,500
3	63	$319,900
4	43	$307,500
Total	**197**	**$1,241,100**

Source: NOAA, National Climatic Data Center

Significant Historical Events:

- January 24-25, 2000

  A nor'easter spread heavy snow into Virginia during the night of the 24th and through the 25th. Several inches of snow was on the ground at daybreak, with winds gusting at 25 to 45 mph creating blizzard conditions in some areas. The region was at a standstill. Airports and transit systems were shut down. Schools were closed. Federal, State and County government offices were closed or quickly closed once the full impact of the storm was realized. Some federal employees in Northern Virginia who began their commutes before the government shutdown were left battling the storm in their attempts to return home.

- March 9, 1999

  Heavy snow fell across the region. Schools were closed and some stayed home with the children, but many others found themselves at work and on the roads in rapidly deteriorating conditions. In the heaviest band, snow was falling at a rate of 2 inches per hour making it hard for road crews to keep up. Cars were stuck in snow and abandoned and soon littered the roadways making plowing even more difficult and travel for others even more hazardous. Ronald Reagan Washington National Airport and Washington-Dulles International Airport were closed for

nearly most of the day. Loudoun County alone reported 53 vehicle accidents and 18 injuries. For those schools that do not close, 24 school buses got stuck on rural routes. At least 200 abandoned, damaged, or stuck vehicles had to be towed off Interstates 95 and 66. Fairfax County reported 500 disabled vehicles and 30 injuries in just six hours.

- January 6-13, 1996

  On the morning of January 6th, much of Virginia and the Washington DC area was buried under two feet of snow. Many rural and some residential areas did not see a snow plow for five days. The Federal government remained shut down for four days. Many local governments and businesses were also closed. Schools announced their closure for the entire week and some were closed longer. A second storm struck on Friday, January 12th dumping another two to six inches. Snowfall totals across the region ranged from 19 inches in Prince William County to 35 inches in Loudoun County.

- February 2-3 and February 16, 1996

  A continuing series of Alberta clippers followed by strong nor'easters struck the region. The storm on February 2nd and 3rd dropped 6 to 10 inches of snow. On the 16th, a nor'easter moved up the coast dumping and additional six to 12 inches of snow.

- March 13-14, 1993

  The "Superstorm of March '93" was also known as "The Storm of the Century" for the eastern United States, due to its large area of impact, all the way from Florida and Alabama through New England. The storm was blamed for some 200 deaths and cost a couple billion dollars to repair damages and remove snow. In a large swath from Alabama to New England, it dropped over a foot of snow. As the storm's center crossed Virginia, weather stations recorded their lowest pressure ever. It brought heavy snow and blizzard conditions over portions of the region, and some roofs collapsed under the weight of the snow.

- February 18-19, 1979

  "The Presidents Day Storm" was considered the worst storm in 57 years to strike Northern Virginia. Snow depths from the storm accumulated up to 20 inches. At times, snow was falling two to three inches per hour and temperatures were in the single digits to teens. Huge tractors and other farm machinery had been driven to the Mall in Washington, DC to protest for higher agricultural pricing. When the storm hit, the farmers used their equipment to help locals dig out of nearly two feet. Four deaths were attributed to heart attacks from stress due to overexertion during and after the storm, and 18 injuries occurred from falls on ice.

- February 15-16 and March 20-21, 1958:

  Over 14 inches of snow fell in Northern Virginia in mid-February. Transportation was paralyzed, and two deaths were attributed to the storm. Another nor'easter struck on March 21st, dropping another 10 to 15 inches across the region.

Probability of Future Occurrences:

- Winter storms will remain a highly likely occurrence for the entire Northern Virginia region.

Erosion

There is no known database of historic erosion events in the Northern Virginia region. Erosion events are often extremely localized in nature and often go unreported unless they threaten or cause damage or destruction to infrastructure or other property.

As discussed in Section 4: Hazard Identification, the implementation of erosion control measures such as the restoration of vegetation is typically needed to minimize the adverse effects associated with erosion. These measures are addressed in the Northern Virginia region through local sedimentation and erosion control programs. While local erosion hazard areas are not identified, the areas of greatest concern are typically those areas consisting of steep slopes and fast running stream channels, as well as large construction sites involved in the excavation and disturbance of from their natural state.

As far as coastal and tidal erosion, Prince William, Fairfax, and Arlington Counties and the City of Alexandria all have tidal shorelines along the Potomac River and its associated embayments and tributaries. The accretion and erosion of these shorelines are greatly influenced by wind-induced waves, littoral currents, tidal currents, sea-level rise, boat wake, and stormwater runoff. Other contributing factors include the physical characteristics of the shoreline (e.g. topography, soil) as well as human activities (e.g. land use, dredging, and shoreline stabilization).

In September 1992, NVRC prepared a study entitled "*Tidal Shoreline Erosion in Northern Virginia*" which discusses the erosion situation for various segments of the shoreline in the Northern Virginia region as well as identifies the locations of "priority" erosion concern. The report is intended to serve as a valuable resource document for state and local officials to assist them in planning for shoreline and erosion control throughout Northern Virginia, and is hereby incorporated by reference. In addition, the report augments a DBase IV computer data file also created by NVRC that contains the names, mailing addresses, and tax parcel numbers of tidal Potomac shoreline property owners. This data is distributed to the Shoreline Erosion Advisory Service (SEAS) and Northern Virginia local governments. Combined with the set of approximately 360 low altitude aerial photographs, these work products serve as an excellent historical record for current planning efforts, and also future research.

According to the report, 20% of the Northern Virginia shoreline has been artificially stabilized with 32 miles of hard structures. Prince William County is approximately 48 miles in length and has 8.7 miles of artificial shoreline stabilization structures. Fairfax has the most tidal shoreline in Northern Virginia (87 miles), and the most artificial stabilization (13.3 miles), but the smallest percent of shoreline stabilized (15%). The City of Alexandria has the shortest shoreline length (8.8 miles), with the largest percent stabilized (58%, or 5.1 miles). Arlington County has 13.3 miles of tidal shoreline, with 4.9 miles of hardened shoreline (37%).

Probability of Future Occurrences:

- Erosion will remain a likely occurrence in localized areas throughout the Northern Virginia region.

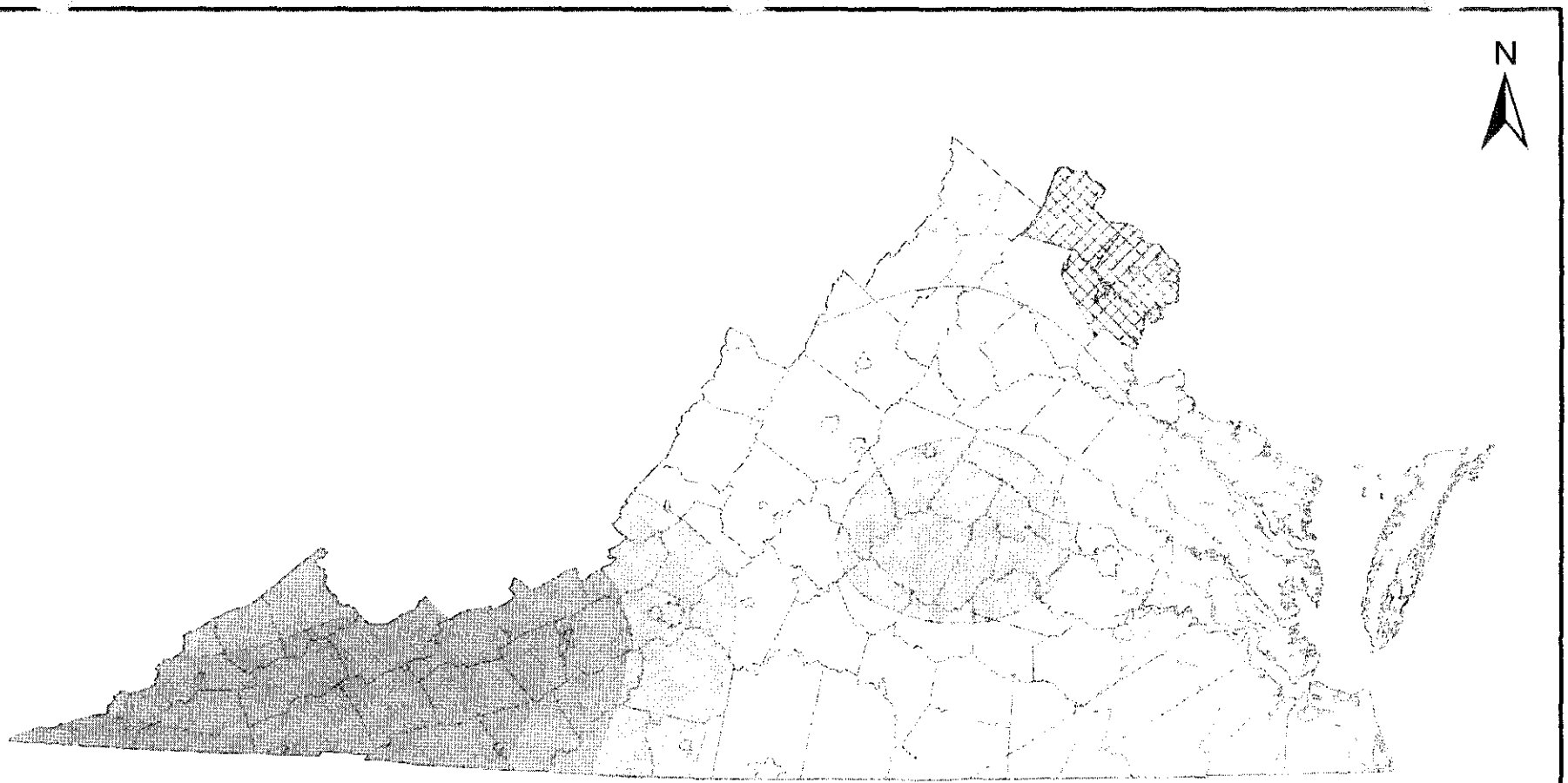
Earthquakes

Similar to other states on the eastern seaboard, the state of Virginia is designated as a moderate risk state for earthquake occurrence by the USGS. Earthquake events can and occasionally do occur in the state, though of much less intensity than those that occur along the west coast. The greatest seismic risk in Virginia is in the Eastern Tennessee Seismic Zone, located in the southwestern portions of the state and far from the Northern Virginia region. This is illustrated in **Figure 5.8**, which shows seismic risk for the state of Virginia based upon peak acceleration (%g) with a 10 percent probability of exceedance in 50 years[11].

The first recorded earthquake in Virginia occurred in 1774. Since then, more than 300 earthquakes have occurred in the state, with 18 having a magnitude of 4.5 or higher on the Richter Scale[12]. The largest of these events occurred in Giles County in 1897 with a magnitude of 5.8. The last notable seismic event to occur in Virginia was on December 9, 2003 in the Central Virginia Seismic Zone near Richmond. Most earthquake events have resulted in very little property damage, if any, and there are no historical records of any earthquake-related damages in the Northern Virginia region.

According to the USGS, there have been 62 significant earthquake events to occur within 300 miles of the Northern Virginia region (including those centered outside of Virginia). The epicenter locations of these events are shown in **Figure 5.9** along with the year in which they occurred. There are no reported casualties or significant property damages for the Northern Virginia region as a result of these events.

[11] Peak ground acceleration represents a model showing the probability that ground motion will reach a certain level during an earthquake. It is further described in Section 4: Hazard Identification (see Figure 4.8, which illustrates a similar seismic risk map for the entire continental United States).
[12] The Richter Scale may be found in Section 4: Hazard Identification (Table 4.6).

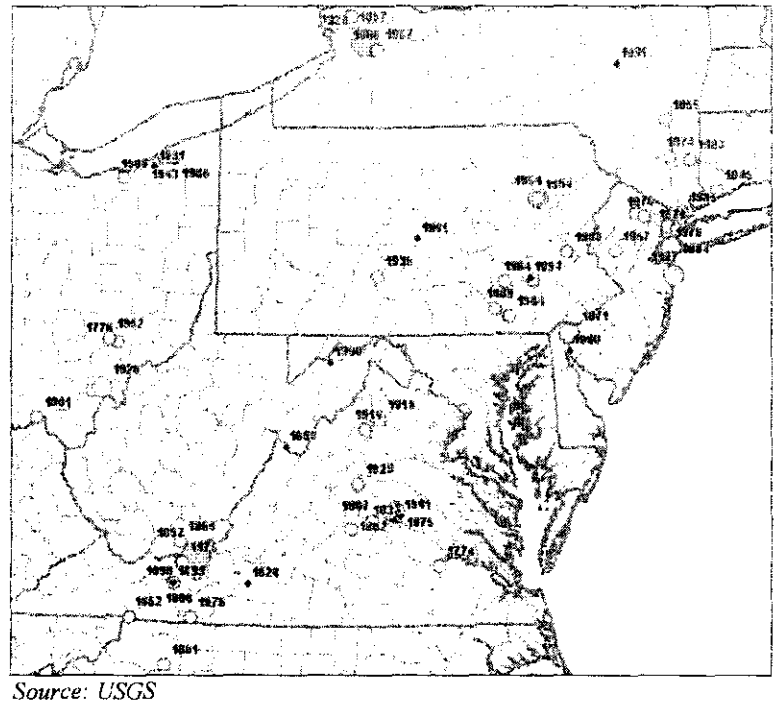


NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 5.8

Seismic Risk in Virginia

Figure 5.9
Significant Earthquakes within 300 Miles of the Northern Virginia Region



Source: USGS

Significant Historical Events (in Virginia[13]):

- April 9, 1918

  The Shenandoah Valley region was strongly shaken by an earthquake. It was called the "most severe earthquake ever experienced" at Luray. Although little damage resulted, people in many places over the northern valley region were greatly alarmed and rushed from their houses. Broken windows were reported at Washington, DC. The tremor was noticed by President Wilson and his family at the White House; the President's secretary called a newspaper office to learn the cause of the terrifying noise. The felt area extended over 155,000 square kilometers, including parts of Maryland, Pennsylvania, and West Virginia.

- May 31, 1897

  This is the largest historical earthquake to originate in Virginia. The epicenter was in Giles County, where on May 3rd, an earlier tremor at Pulaski, Radford, and Roanoke had caused damage. Loud rumblings were heard in the epicentral region at various times between May 3rd and 31st. The shock on the latter date was felt from Georgia to Pennsylvania and from the Atlantic Coast westward to Indiana and Kentucky, an area covering about 725,000 square kilometers. It was especially strong at Pearisburg, where the walls of old brick houses were cracked and bricks were thrown from chimney tops. Springs were muddied and a few earth

[13] Historical event information for earthquakes in Virginia occurrences is based on information made available through the USGS Earthquake Hazards Program.

fissures appeared. Chimneys were shaken down at Bedford City, Houston, Pulaski, Radford, and Roanoke. Chimneys were also broken at Raleigh, North Carolina, Bristol and Knoxville, Tennessee, and Bluefield, West Virginia. Minor tremors continued in the epicentral region from time to time until June 6; other disturbances felt on June 28, September 3, and October 21 were probably aftershocks.

- August 31, 1861

  The epicenter was probably in extreme southwestern Virginia or western North Carolina. At Wilkesboro, North Carolina, bricks were shaken from chimneys. The lack of Virginia reports may perhaps be ascribed to the fact that the Civil War was under way and there was rather heavy fighting in Virginia at the time. This shock affected about 775,000 square kilometers and was felt along the Atlantic coast from Washington, DC, to Charleston, South Carolina, and westward to Cincinnati, Louisville, and Gallatin, Tennessee, and southwestward to Columbus, Georgia.

- April 29, 1852

  Another moderately strong, widely felt shock occurred. At Buckingham and Wytheville, chimneys were damaged. The felt area extended to Washington DC, Baltimore, Maryland, and Philadelphia, Pennsylvania, and also included many points in North Carolina - approximately 420,000 square kilometers.

- August 27, 1833

  The earthquake covered a broad felt area from Norfolk to Lexington and from Baltimore, Maryland, to Raleigh, North Carolina - about 135,000 square kilometers. Two miners were killed in the panic the shock caused at Brown's Coal Pits, near Dover Mills, about 30 kilometers from Richmond. At Charlottesville, Fredericksburg, Lynchburg, and Norfolk, windows rattled violently, loose objects shook, and walls of buildings were visibly agitated.

- March 9, 1828

  An earthquake, apparently centered in southwestern Virginia, was reported felt over an area of about 565,000 square kilometers, from Pennsylvania to South Carolina and the Atlantic Coastal Plain to Ohio. Very few accounts of the shock were available from places in Virginia; it was reported that doors and windows rattled. President John Quincy Adams felt this tremor in Washington DC, and provided a graphic account in his diary. He compared the sensation to the heaving of a ship at sea.

- February 21, 1774

  A strong earthquake was felt over much of Virginia and southward into North Carolina. Many houses were moved considerably off their foundations at Petersburg and Blandford. The shock was described as "severe" at Richmond and "small" at Fredericksburg. However, it "terrified the inhabitants greatly." The total felt area covered about 150,000 square kilometers.

Probability of Future Occurrences:

- Earthquakes of significant magnitude are unlikely occurrences for the entire Northern Virginia region.

Sinkholes

Sinkholes are rare in Virginia, but they can occur throughout the state. They are most prevalent in karst terrains, where voids are formed by the natural dissolution of soluble rock such as limestone, dolomite, and gypsum. They may also occur due to human activities such as the lowering of the water table in unconsolidated soils, or underground mining activities.

According to the Virginia Department of Mines, Minerals and Energy, sinkholes are very rare in the Northern Virginia region and do not pose a significant risk. The existing soil types are not conducive to creating natural sinkholes, and those that do occur are related to soil piping or the dissolution of sparse carbonate rock. For example, water leaking from culverts or other drainage structures can create a void beneath the drainage structure by compaction or internal scour of the soil. This reduction in support can result in displacement of the leaking structure and an increase in leakage or breakage. The void may increase in size to the extent that the soil has insufficient strength to support itself with subsequent failure leading to the formation of a steep sided collapse sinkhole. For example, on August 11, 2001 heavy rainfall washed out a culvert and created a sinkhole in Arlington County, though no damages were reported.

No maps of past occurrences are available for the sinkhole hazard due to the fact that there have been very few notable incidents reported within the Northern Virginia region. Additionally, no known sources of sinkhole probability data exist for the region.

Probability of Future Occurrences:

- Sinkholes remain a possible occurrence in localized areas of the Northern Virginia region.

Landslides

While mountainous areas in Virginia are the most susceptible to landslide events, landslide and subsidence hazards do exist elsewhere in the state, including the Northern Virginia region – though these events are quite rare and limited in terms of their impact on people and property.

Minor landslide events are possible in localized, steep-sloped areas of the Northern Virginia region during extremely wet conditions. **Figure 5.10** provides a general indication of where landslide events are most likely to occur based on landslide incidence and susceptibility data provided by the USGS[14]. These areas are primarily located in western Loudoun County, as well as some areas of moderate risk in extreme eastern areas of Fairfax and Prince William counties.

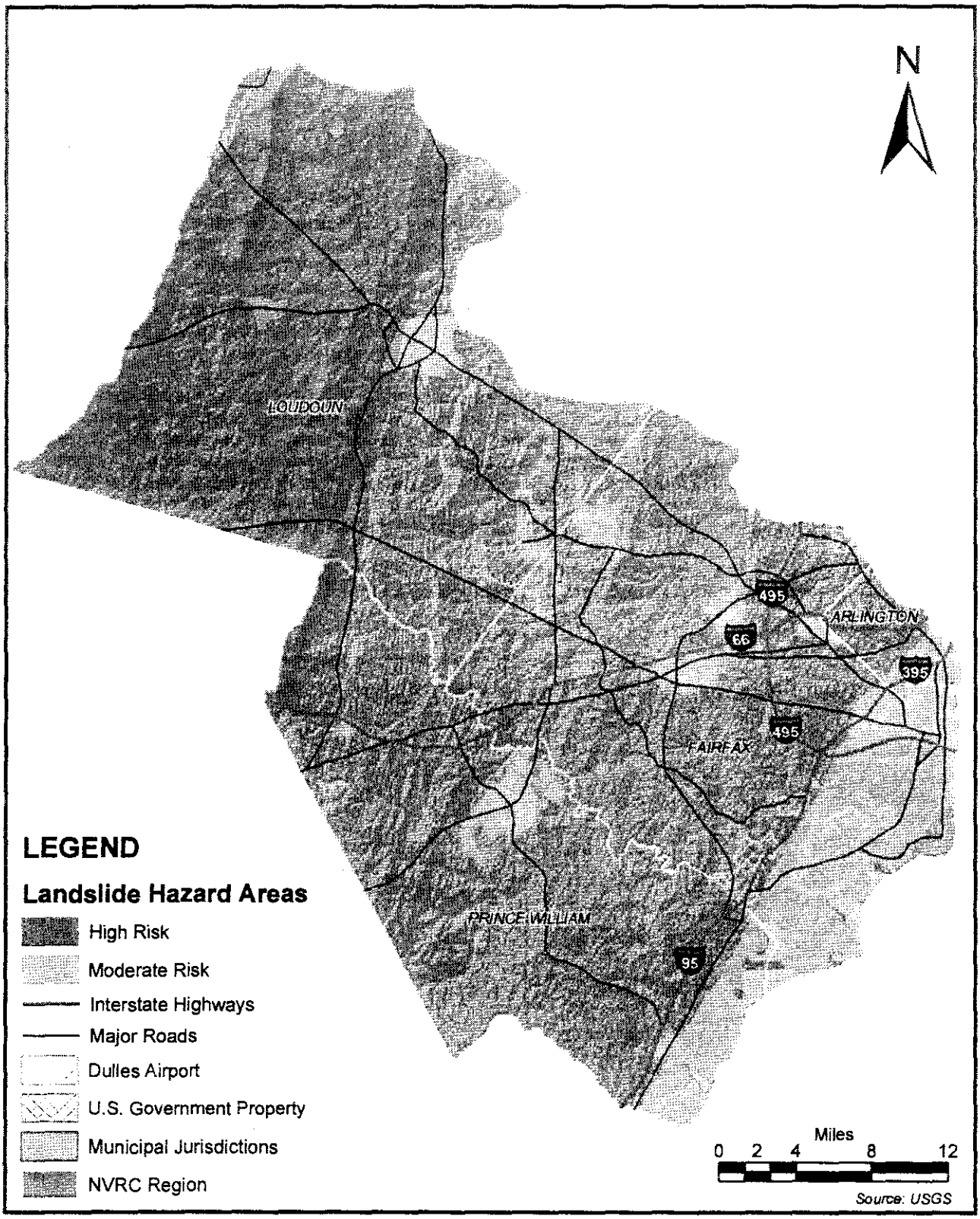
There are no historical records on any significant landslide events in the Northern Virginia region. While some slope stability problems have been associated with marine clay in Fairfax County (marine clay becomes unstable when waterlogged), these problems soils are typically addressed before and during construction through required site improvements such as retaining structures and other slope stabilization techniques.

In June of 2003, a minor landslide occurred in the Landsdowne neighborhood of Fairfax County, breaching a retaining wall, disrupting underground utility lines and threatening ten homes. According to local officials this was a very isolated incident brought on by heavy spring rains and should not indicate the area is prone to recurring landslides.

Probability of Future Occurrences:

- Landslides remain a possible occurrence in localized areas of the Northern Virginia region.

[14] The data used to illustrate landslide hazard areas in Figure 5.10 is taken from the same dataset used in national base map presented and further discussed in Section 4: Hazard Identification (see Figure 4.9).



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 5.10

Landslide Hazard Areas

Dam/Levee Failure

According to the National Inventory of Dams maintained by the U.S. Army Corps of Engineers[15], there are twelve (12) major dams located in the Northern Virginia region. Major dams are defined as dams being 50 feet or more in height, or with a normal storage capacity of 5,000 acre-feet or more, or with a maximum storage capacity of 25,000 acre-feet or more. The state regulatory agency for dams is the Virginia Department of Conservation and Recreation (DCR) through the Dam Safety and Floodplain Management Program. In addition to the twelve major dams discussed here, the Virginia DCR tracks and regulates a number of other smaller dams (e.g. farm pond impoundments, etc.) that present less severe hazard threats.[16] There are no major levees located in the Northern Virginia region.

Of the twelve major dams located in the region, six are classified as "high" hazards where failure or mis-operation of the dam will probably cause loss of human life. Another five major dams are classified as "significant" hazards, where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. Only one of the twelve major dams is classified as a "low" hazard. It is important to note that these hazard classifications are not related to the physical condition or structural integrity of the dam (nor the probability of its failure) but strictly to the potential for adverse downstream effects if the dam were to fail.

Table 5.12 lists some of the descriptive information made available for each of the twelve major dams in the Northern Virginia region, while each of their general locations are illustrated in **Figure 5.11**.

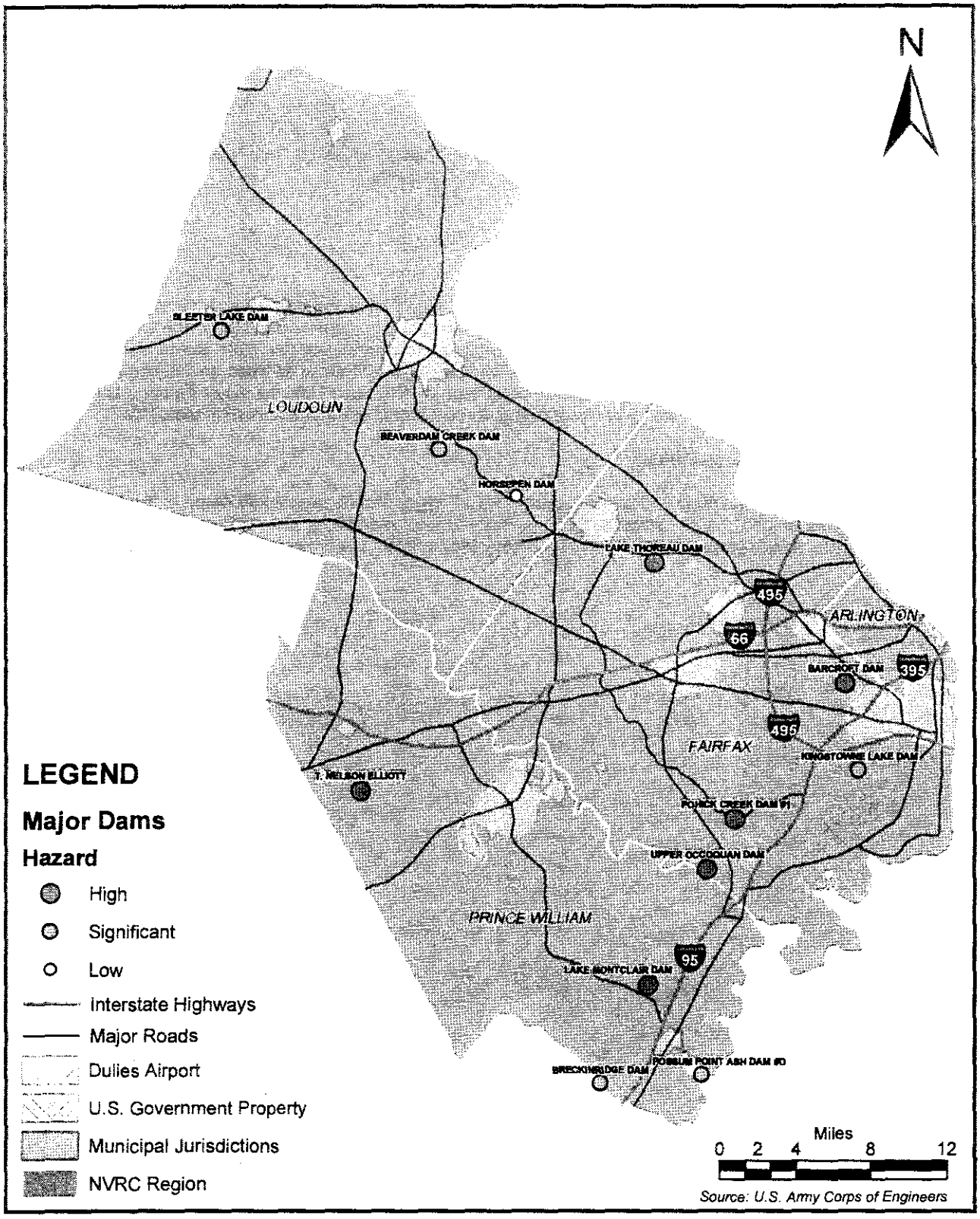
Table 5.12
Major Dams in the Northern Virginia Region

Dam Name	Hazard Class	Drainage Area (Sq. Mi.)	Primary Purpose	Owner
Upper Occoquan	High	595	Hydroelectric	Fairfax County Water Authority
T. Nelson Elliott	High	74	Hydroelectric	City of Manassas
Barcroft	High	15	Recreation	Lake Barcroft Watershed Improv. Dist.
Lake Montclair	High	11	Recreation	Montclair Property Owners Association
Pohick Creek #1	High	6	Flood Control	Fairfax County Board of Supervisors
Lake Thoreau	High	1	Recreation	Reston Home Owners Association
Sleeter Lake	Significant	10	Irrigation	Round Hill Associates
Beaverdam Creek	Significant	6	Water Supply	City of Fairfax
Kingstowne Lake	Significant	1	Recreation	Kingstowne Limited Partnership
Possum Point Ash	Significant	< 0	Debris Control	Virginia Power
Breckinridge	Significant	< 0	Water Supply	U.S. Department of Defense (USMC)
Horsepen	Low	23	Other	Metro-Washington Airport Authority

Source: U.S. Army Corps of Engineers

While dam failures are not common occurrences, there have been some notable recent events throughout Virginia. In 1995, torrential rains burst the Timberlake Dam in Campbell County, killing two

[15] The National Inventor of Dams was developed by the U.S. Army Corps of Engineers in cooperation with FEMA's National Dam Safety Program. The full inventory contains over 75,000 dams, of which 7,700 are classified as major, and is used to track information on the country's water control infrastructure.
[16] The Virginia Department of Conservation and Recreation maintains additional data on state-regulated dams in the Northern Virginia region, as well as information on the potential impact upon failure.



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 5.11

Major Dams

people downstream in the flooding. Following Hurricane Floyd in 1999, 13 dam failures were reported across the eastern portion of the state causing significant damages.

Significant Historical Events:

- June 1972

  The Barcroft dam in Fairfax County failed during heavy rains associated with Hurricane Agnes Although it caused no loss of life, the dam failure resulted in extreme damage to the Holmes Run area, most notably the tearing out and destruction of an overpass at Van Dorn Street and Holmes Run ($300,000 plus an additional $200,000 to clear away 29 acres of trees and debris from the stream). The dam, which had originally been built in 1913, also suffered major damage and had to be rebuilt in order to restore Lake Barcroft, a recreational area for community residents.

Probability of Future Occurrences:

- Dam failure remains an unlikely occurrence for all major and non-regulated dams in the Northern Virginia region. The Virginia DCR is tasked with monitoring the routine inspection and maintenance of those dams that present the greatest risk or are in need of structural repair.

VULNERABILITY ASSESSMENT

The Vulnerability Assessment section builds upon the information provided in the Hazard Analysis by identifying community assets and development trends in the Northern Virginia region, then assessing the potential impact and amount of damage that could be caused by each hazard event. The primary objective of the assessment is to prioritize the hazards of concern to the region and to identify hazard mitigation strategies that will reduce or eliminate their effects.

To complete the assessment, best available data was collected from a variety of sources, including local, state and federal agencies, and multiple analyses were performed qualitatively and quantitatively (further described below). Additional work will be done on an ongoing basis to enhance, expand and further improve the accuracy of the baseline established here, and it is expected that this vulnerability assessment will continue to be refined through future plan updates as new data and loss estimation methods or tools become available to NVRC and its jurisdictions.

The findings presented in this section with regard to vulnerability were developed using best available data, and the methodologies applied have resulted in an approximation of risk. These estimates should be used to understand relative risk from hazards and the potential losses that may be incurred; however, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning specific hazards and their effects on the built environment, as well as incomplete data sets and from approximations and simplifications that are necessary in order to provide a meaningful analysis. Further, most data sets used in this assessment contain relatively short periods of records which increases the uncertainty of any statistically-based analysis.

44 CFR Requirement

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

Methodologies Used

To drive the risk assessment effort for the Northern Virginia region, two distinct methodologies were applied. The first includes a ***quantitative*** analysis that relies upon best available data and technology, while the second methodology includes a ***qualitative*** analysis that relies more on local knowledge and rational decision making. Upon completion, the methodologies are combined to create a "hybrid" approach for assessing hazard vulnerability for the Northern Virginia region that allows for some degree of quality control and assurance. The quantitative assessment focuses on estimated hazard loss estimates and specifically at-risk community assets, while the qualitative assessment is comprised of a scoring system built around values assigned by the Mitigation Advisory Committee as to the likelihood of occurrence, spatial extent and potential impact of each hazard studied.

The methodologies are briefly introduced here and are described in more detail throughout this section.

Quantitative Methodology

The quantitative methodology consists of utilizing HAZUS®MH, a geographic information system (GIS)-based loss estimation software available from the Federal Emergency Management Agency as well as a

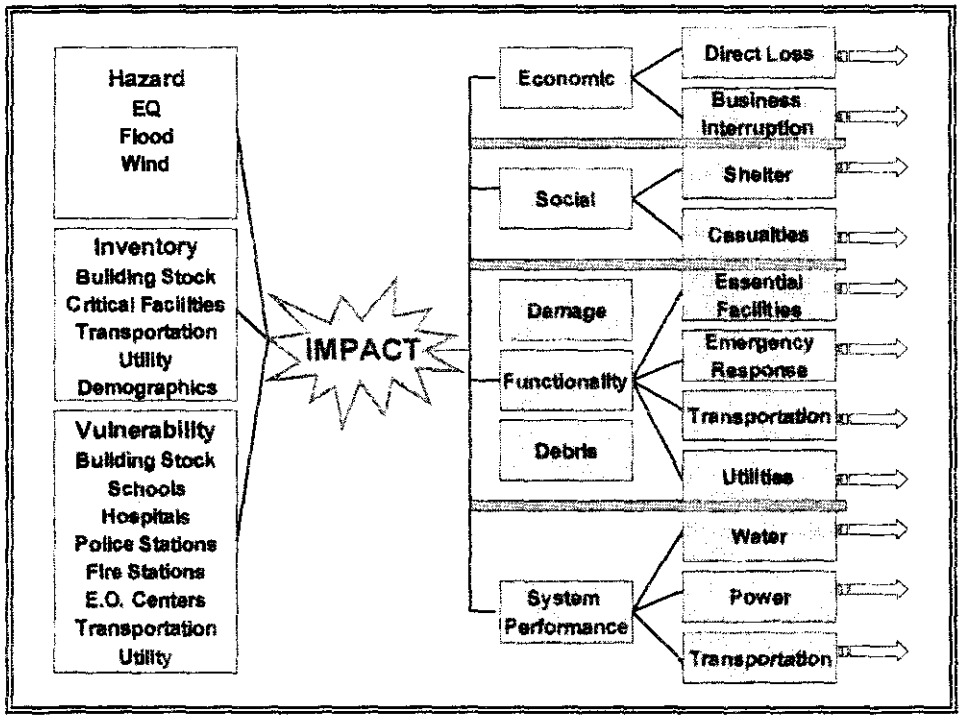
detailed GIS-based approach independent of the HAZUS^{MH} software. These two GIS-based studies together help form a quantitative risk assessment.

Explanation of HAZUS^{MH} Risk Assessment Methodology

HAZUS^{MH} is FEMA's nationwide standardized loss estimation software package, built upon an integrated GIS platform with a national inventory of baseline geographic data (including information on the Northern Virginia region's general building stock and dollar exposure). Originally designed for the analysis of earthquake risks, FEMA has expanded the program to allow for the analysis of multiple hazards including flood and wind events. By providing estimates on potential losses, HAZUS^{MH} facilitates quantitative comparisons among hazards and may assist in the prioritization of hazard mitigation activities.

HAZUS^{MH} uses a statistical approach and mathematical modeling of risk to predict a hazard's frequency of occurrence and estimated impacts based on recorded or historic damage information. The HAZUS^{MH} risk assessment methodology includes distinct hazard and inventory parameters. For example, wind speed and building type were modeled using the HAZUS^{MH} software to determine the impact (damages and losses) on structures. **Figure 6.1** shows a conceptual model of HAZUS^{MH} methodology. More information on HAZUS^{MH} loss estimation methodology is available through FEMA at www.fema.gov/hazus.

Figure 6.1
Conceptual Model of HAZUS^{MH} Methodology



This risk assessment utilized HAZUS^{MH} to produce regional profiles and estimated losses for two of the hazards addressed in this section: hurricane winds and earthquake. For each of these hazards, HAZUS^{MH} was used to generate probabilistic "worst case scenario" events to show the maximum potential extent of damages. It is understood that those events which could occur of less severe magnitude would likely result in fewer losses than those calculated here.

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

The first step in conducting the GIS-based (non- HAZUS^{MH}) risk assessment included the collection of relevant GIS data from local, state and national sources. This began with the collection of local data from each participating jurisdiction through NVRC (considered most accurate), then continued up to best available data at the national inventory level (considered least accurate). The data determined to be "best available" was then used for purposes of this assessment.

In order to generate hazard loss estimates beyond hurricane winds and earthquake, the following steps were conducted independent of the HAZUS^{MH} software:

- For the flood, drought, severe thunderstorm, tornado, wildfire and winter storm hazards, best available data on historical hazard occurrences (limited to NOAA National Climatic Data Center and Virginia Department of Forestry records) was used to produce an annualized loss estimate of potential damages. Using this data, annualized loss estimates were generated by totaling the amount of property damage over the period of time for which records were available, and calculating the average annual loss. GIS was used to show the correlations between potential future events and residential population distribution throughout the region. Future plan updates may also incorporate place-of-business population distribution to better reflect the vulnerability of human life inherent during traditional working hours. In instances where multiple counties or cities are affected by an event and the value for property damage reflects the total for the affected area, professional judgment was used in extracting a reasonable share for the Northern Virginia region (or particular counties) to produce an annualized loss estimate of potential damages for the area.

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

In addition to generating annualized loss estimates for particular hazards, GIS technology was further utilized to identify, quantify and analyze potentially at-risk community assets such as people, public buildings, critical facilities and infrastructure. This analysis was completed for hazards that can be spatially defined in a meaningful manner (i.e., hazards with an officially determined geographic extent) and for which digital GIS data layers are readily available. For the Northern Virginia region, this includes the hazards of flooding, landslides and wildfires. The analysis resulted in the identification of potentially at-risk community assets based upon their location in relation to identified hazard areas. For the flood hazard, ESRI® ArcGIS™ 8 was used to further assess risk utilizing digital flood hazard data (based on FEMA Q3 data) in combination with locally-available GIS data layers. Primary data layers used include local tax records for individual parcels and building footprint data. Using these data layers, where available, total floodplain exposure was determined for each jurisdiction by calculating the assessed building value for all pre-FIRM[1] structures located in identified flood hazard areas. Exposure values do not include any estimated values for building contents.

Qualitative Methodology

The qualitative assessment relies less on technology, but more on historical and anecdotal data, community input and professional judgment regarding expected hazard impacts. The qualitative

[1] The methodology used for determining potential flood loss estimates assumes that pre-FIRM structures would not have been constructed to minimum NFIP standards, and therefore are more likely to be vulnerable to the flood hazard than post-FIRM structures. Pre-FIRM structures were identified by comparing the date of construction for each structure to the NFIP entry date for that jurisdiction.

assessment completed for the Northern Virginia region is based on the Priority Risk Index (PRI), a tool used by PBS&J to measure the degree of risk for identified hazards in local communities. The PRI is also used to assist community officials in ranking and prioritizing those hazards which pose the most significant threat to their area based on a variety of important factors.

While the quantitative assessment focuses on using best available data, computer models and GIS technology, the PRI system relies more on historical data, local knowledge and the general consensus of the Mitigation Advisory Committee. The PRI is used for hazards with no available GIS data or relevant information to perform quantitative analysis, and also provides an important opportunity to compare, crosscheck or validate the results of those that do have available data.

The PRI results in numerical values that allow identified hazards to be ranked against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk to five categories for each hazard (probability, impact, spatial extent, warning time, and duration). Each degree of risk has been assigned a value (1-4) and an agreed upon weighting factor[2], as summarized in **Table 6.1**.

To calculate the PRI value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final PRI value, as demonstrated in the example equation below:

PRI Value = [(Probability x .30) + (Impact x .30) + (Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]

According to the weighting scheme applied for the Northern Virginia region, the highest possible PRI Value is **4.0**. Prior to being finalized, PRI values for each hazard were reviewed and accepted by the Mitigation Advisory Committee.

Summary

Using both the qualitative and quantitative analyses to evaluate the hazards that impact the region provides members of the Mitigation Advisory Committee with a dual-faceted review of the hazards. This allows officials to not only recognize the potentially most costly hazards, but also to plan and prepare for hazards that although not causing much monetary damage could put a strain on the local resources needed to recover after their impact on the region.

All conclusions of the vulnerability assessment completed for the Northern Virginia region are presented in "Conclusions on Hazard Risk" at the end of this section. Findings for each hazard are detailed in the hazard-by-hazard vulnerability assessment which follows, beginning with an overview of general asset inventory and exposure data for the Northern Virginia region.

[2] The PRI weighting scheme may also be adjusted by the Mitigation Advisory Committee based upon any unique concerns for the region.

Table 6.1
Summary of Priority Risk Index (PRI)

PRI Category	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 100% annual probability	3	
	Highly Likely	100% annual probability	4	
Impact	Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50 and 100% of area affected	4	
Warning Time	More than 24 hours	Self explanatory	1	10%
	12 to 24 hours	Self explanatory	2	
	6 to 12 hours	Self explanatory	3	
	Less than 6 hours	Self explanatory	4	
Duration	Less than 6 hours	Self explanatory	1	10%
	Less than 24 hours	Self explanatory	2	
	Less than one week	Self explanatory	3	
	More than one week	Self explanatory	4	

Overview of Exposure for the Northern Virginia region

Population

According to the U.S. Census Bureau, the total population of the Northern Virginia region in 2000 was approximately 1.8 million. The average number of persons per square mile was 1,380, making the region one of the most densely populated in the United States. **Table 6.2** shows the total population counts and a breakdown of population density per square mile, by jurisdiction. As can be seen in the table, the City of Alexandria is the densest jurisdiction while Loudoun County is the least dense. **Figure 6.2** illustrates the distribution of population density across the region according to census tracts.

Table 6.2
Population Statistics in the Northern Virginia Region, by Jurisdiction (2000)

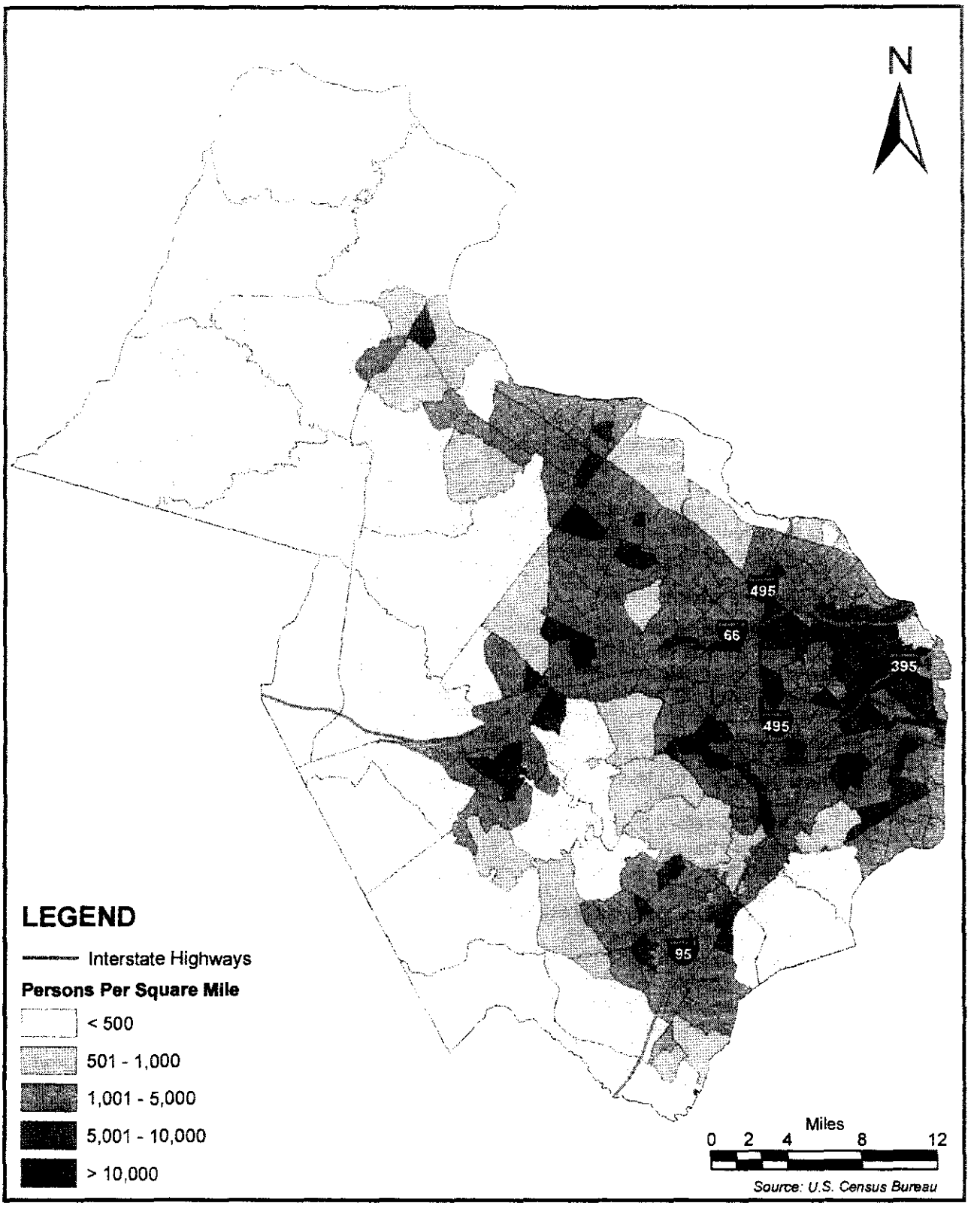
Jurisdiction	Population	Population Density (Per Square Mile)
Arlington County	189,453	7,315
Fairfax County	933,641	2,413
Loudoun County	137,704	272
Prince William County	275,876	819
Alexandria, City of	128,283	8,385
Fairfax, City of	21,498	3,467
Falls Church, City of	10,377	5,189
Manassas, City of	35,135	3,514
Manassas Park, City of	10,290	5,717
Dumfries, Town of	4,937	3,086
Herndon, Town of	21,655	5,156
Leesburg, Town of	28,311	2,441
Purcellville, Town of	3,584	1,493
Vienna, Town of	14,453	3,285
Total	**1,815,197**	**1,380**

Source: U.S. Census Bureau

General Building Stock

The total dollar exposure of buildings within the Northern Virginia region is estimated to be approximately $113 billion ($113,285,152,000). This is based on a study of 604,628 residential, commercial, industrial and other buildings located throughout the region, derived from HAZUS^{MH} inventory data.[3] This total dollar exposure does not account for estimated building contents values which are also available through HAZUS^{MH}. When added to total building values, this results in a total exposure value of approximately $181 billion ($181,105,453,000) for buildings and contents in the Northern Virginia region. **Table 6.3** shows the estimated total exposure values by planning area[4].

[3] HAZUS^{MH} uses Census 2000 and Dunn and Bradstreet (2002) data for its default inventories. Any values unavailable in the current version of the HAZUS^{MH} software are not reflected.
[4] The description of assigned planning areas is provided on page 5:2 of Section 5: Hazard Analysis.



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.2

Population Density

Table 6.3
Total Exposure in the Northern Virginia Region, by Planning Area

Planning Area	Estimated Building Count	Estimated Dollar Exposure	Percent of Regional Exposure
1	48,593	$20.6 Billion	11%
2	380,278	$112.8 Billion	62%
3	65,574	$17.2 Billion	10%
4	110,183	$30.5 Billion	17%
Total	**604,628**	**$180.1 Billion**	**100%**

Source: FEMA (HAZUS^{MH})

Of the approximately $113 billion in total building exposure, 82 percent is classified as residential, followed by 14 percent as commercial and 1.2 percent as industrial property exposure.[5] **Figures 6.3 – 6.5** show the general distribution of residential, commercial and industrial property exposure throughout the region by census tract. As can be seen in the figures, the majority of building exposure is concentrated throughout Arlington and Fairfax counties, as well as the municipal and rural population centers of Loudoun and Prince William counties.

Critical Facilities and Infrastructure

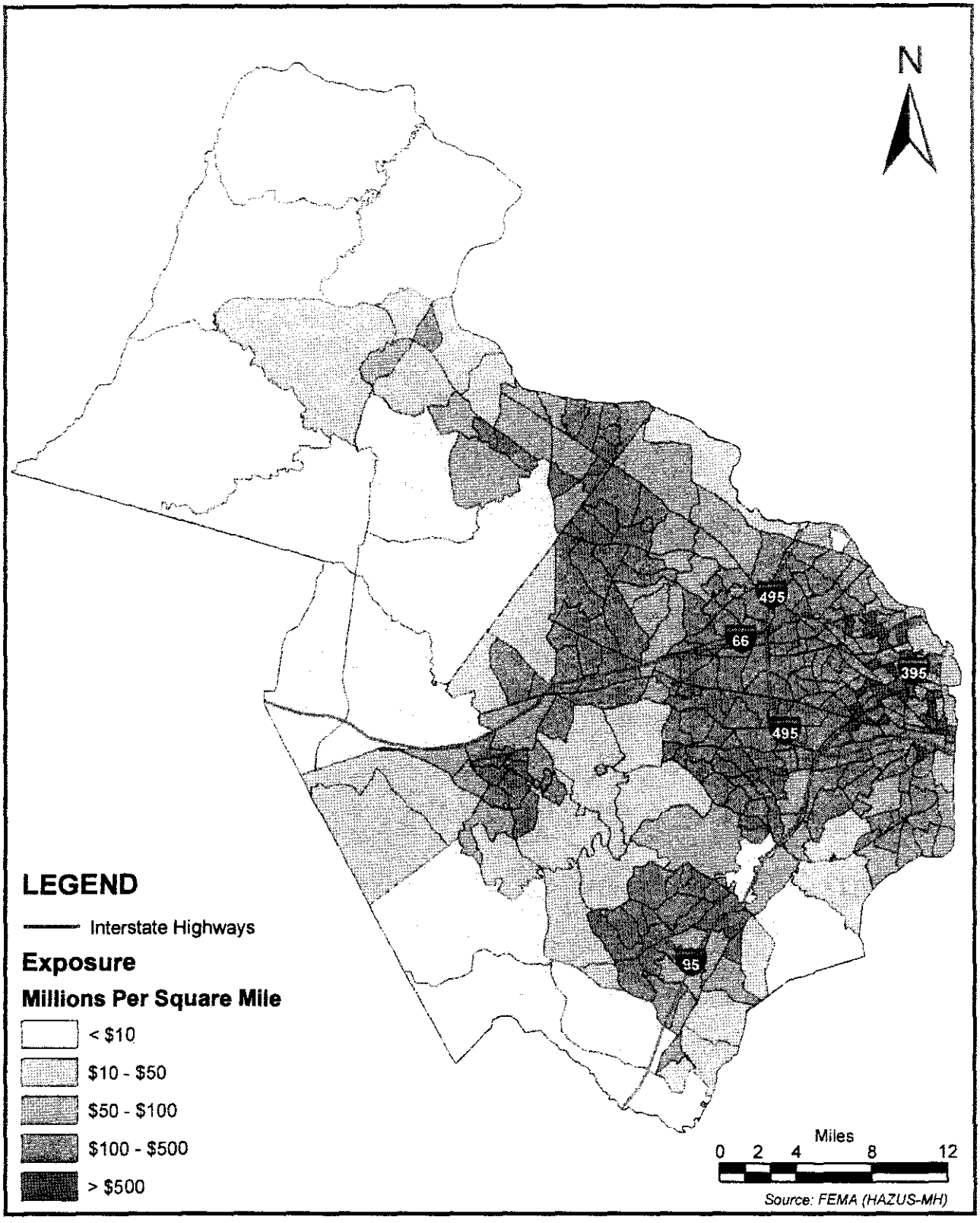
There is no comprehensive database of critical facilities and infrastructure for the Northern Virginia region. Moreover, there is no universally accepted definition of what constitutes critical facilities and infrastructure nor is one associated with FEMA and DMA 2000 planning requirements. For purposes of this Plan, critical facilities and infrastructure are identified as "*those facilities or systems whose incapacity or destruction would present an immediate threat to life, public health, and safety or have a debilitating effect on the economic security of the region.*" This includes the following facilities and systems based on their high relative importance for the delivery of vital services, the protection of special populations, and other important functions in the Northern Virginia region:

- Emergency Operations Centers (EOCs)
- Hospitals and medical care facilities
- Police stations
- Fire stations
- Schools (particularly those designated as shelters)
- Hazardous material facilities
- Potable water facilities
- Wastewater facilities
- Energy facilities (electric, oil and natural gas)
- Communication facilities

In preparing the inventory of critical facilities for the Northern Virginia region, each participating jurisdiction was asked to submit best available GIS data layers for their primary critical facilities to be used in combination with HAZUS^{MH} inventory data[6]. This resulted in the identification of hundreds of critical facilities for the Northern Virginia region. It is understood that this listing is incomplete due to data limitations associated with both the local GIS and HAZUS^{MH} inventories, but that further enhancements to the data will be made over time and incorporated during future plan updates.

[5] The remaining 2.8 percent is classified as agriculture, education, government and religious buildings.

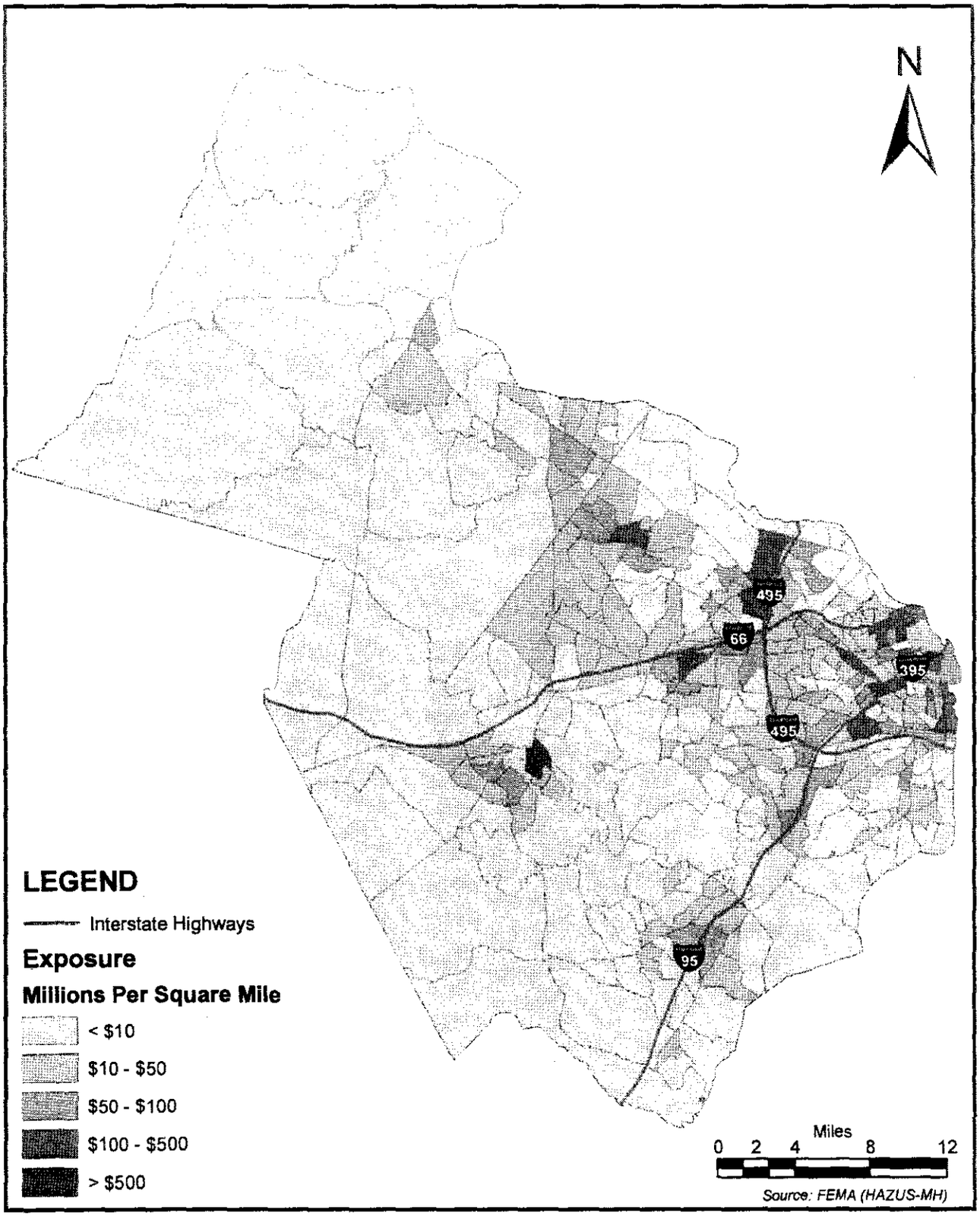
[6] For purposes of this assessment, local GIS data submitted by NVRC or participating jurisdictions was considered best available data (over HAZUS^{MH} inventory data). If no local GIS data was submitted, then HAZUS^{MH} inventory data was considered best available data.



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.3

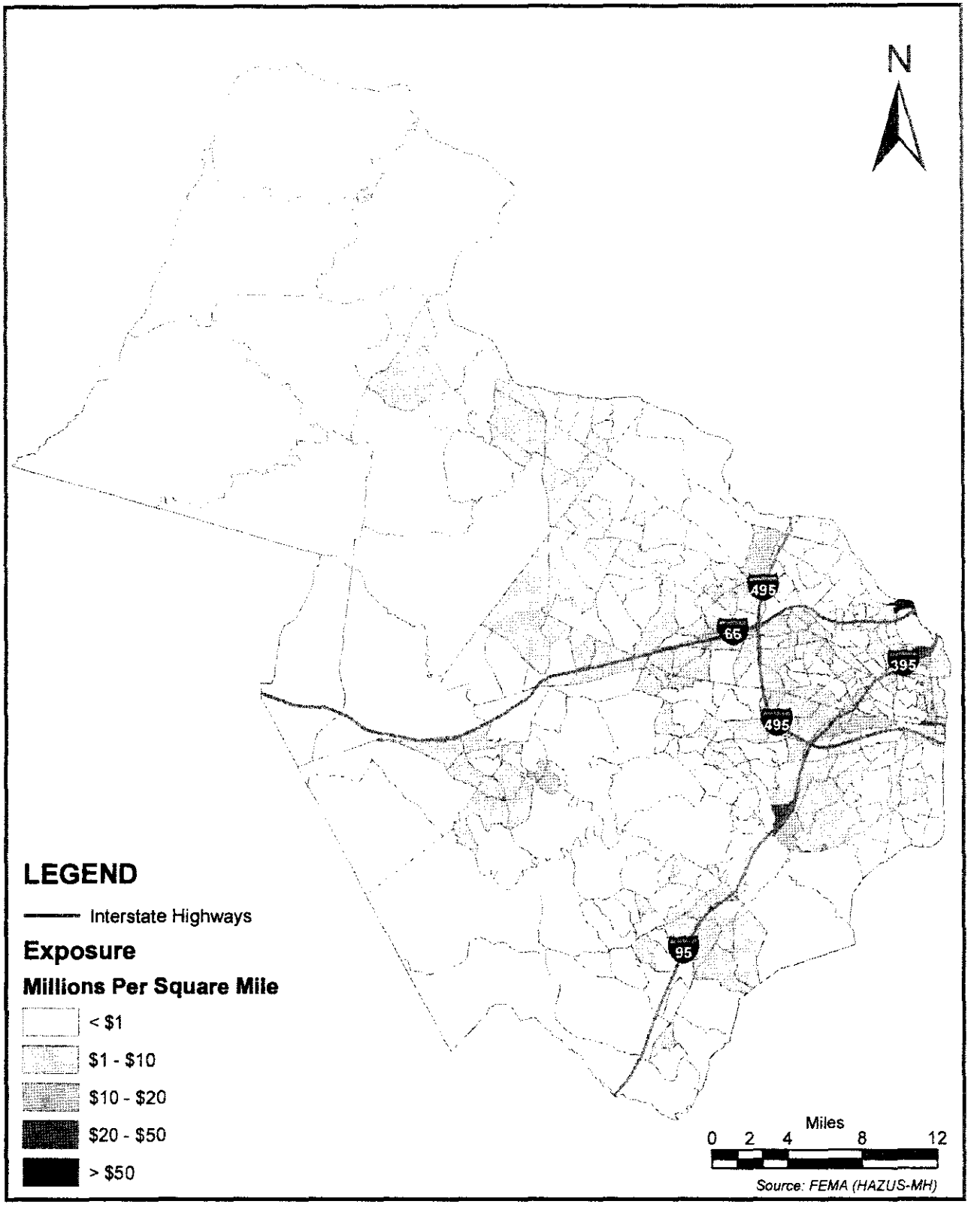
Residential Building Exposure



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.4

Commercial Building Exposure



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.5

Industrial Building Exposure

The vulnerability of each identified critical facility was assessed using GIS analysis by comparing their physical location with the extent of known hazard areas that can be spatially defined through GIS technology. For the Northern Virginia region, this includes flood (100-year flood zones), landslides (areas of high or moderate incidence/susceptibility), and wildfire (areas of high or moderate risk). For purposes of this vulnerability assessment, the other defined hazard areas are not deemed unique enough to make definitive vulnerability assessments for potentially at-risk buildings or facilities that differentiate them from other areas of the region (for example, the insignificant spatial differences in peak ground acceleration for the earthquake hazard).

Of those critical facilities identified in the region, many were indeed determined to be in known hazard areas upon further GIS analysis and thereby determined to be "potentially at-risk". **Tables 6.4 – 6.6** summarize the number of potentially at-risk buildings or facilities in the region to flood, landslide and wildfire, respectively, by jurisdiction and facility type. These determinations are based solely on best available data for critical facility locations and delineable hazard areas for flooding and wildfires, and the actual level of risk for each facility may only be determined by further on-site assessments. For confidentiality and security purposes, specific address information for the identified at-risk facilities was intentionally not included in this plan but is maintained by the NVRC and local emergency management agencies for official use.[7]

Table 6.4
Number of Critical Facilities Potentially At-Risk to Flood

Jurisdiction	Emergency Operations Centers (EOCs)	Hospitals and medical care facilities	Police stations	Fire stations	Schools	Hazardous material facilities	Potable water facilities	Wastewater facilities	Energy facilities	Communication facilities
Arlington County	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
Fairfax County	0	0	0	0	0	0	1	3	0	0
Loudoun County	0	0	1	0	0	0	0	5	0	0
Prince William County	0	0	1	0	0	0	0	3	0	1
Alexandria, City of	0	0	0	0	0	1	0	2	0	0
Fairfax, City of	0	0	0	0	0	0	0	0	0	1
Falls Church, City of	0	0	0	0	0	0	0	0	0	0
Manassas, City of	0	0	0	0	0	0	0	0	0	0
Manassas Park, City of	0	0	0	0	0	0	0	0	0	0
Dumfries, Town of	0	0	0	0	0	0	0	0	0	0
Herndon, Town of	0	0	0	0	0	0	0	0	0	0
Leesburg, Town of	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
Purcellville, Town of	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
Vienna, Town of	0	0	0	0	0	0	0	0	0	0
Total	**0**	**0**	**1**	**0**	**0**	**1**	**1**	**13**	**0**	**2**

* *ND = No digital data available for existing flood hazard areas.*

[7] Specific location information on critical facilities is provided in Section 6A: Critical Facilities Annex (For Official Use Only).

Table 6.5
Number of Critical Facilities Potentially At-Risk to Landslide

Jurisdiction	Emergency Operations Centers (EOCs)	Hospitals and medical care facilities	Police stations	Fire stations	Schools	Hazardous material facilities	Potable water facilities	Wastewater facilities	Energy facilities	Communication facilities
Arlington County	0	1	0	3	0	0	0	1	0	0
Fairfax County	0	5	3	21	34	4	0	4	1	1
Loudoun County	0	1	13	4	16	0	2	7	0	1
Prince William County	0	0	1	0	8	0	0	1	0	0
Alexandria, City of	0	2	1	8	29	1	0	3	1	0
Fairfax, City of	0	0	0	0	0	0	0	0	0	0
Falls Church, City of	0	0	0	0	0	0	0	0	0	0
Manassas, City of	0	0	0	0	0	0	0	0	0	0
Manassas Park, City of	0	0	0	0	0	0	0	0	0	0
Dumfries, Town of	0	0	0	0	0	0	0	0	0	0
Herndon, Town of	0	0	0	0	0	0	0	0	0	0
Leesburg, Town of	0	0	0	0	3	0	0	0	0	0
Purcellville, Town of	0	0	3	0	3	0	0	1	0	0
Vienna, Town of	0	0	0	0	0	0	0	0	0	0
Total	**0**	**9**	**21**	**36**	**93**	**5**	**2**	**17**	**2**	**2**

Table 6.6
Number of Critical Facilities Potentially At-Risk to Wildfire

Jurisdiction	Emergency Operations Centers (EOCs)	Hospitals and medical care facilities	Police stations	Fire stations	Schools	Hazardous material facilities	Potable water facilities	Wastewater facilities	Energy facilities	Communication facilities
Arlington County	0	0	0	0	0	0	0	0	0	0
Fairfax County	0	0	1	3	14	1	2	3	1	0
Loudoun County	0	2	17	4	27	1	4	7	0	1
Prince William County	0	1	2	7	29	0	0	4	0	1
Alexandria, City of	0	0	0	0	0	0	0	0	0	0
Fairfax, City of	0	0	0	0	0	1	0	0	0	0
Falls Church, City of	0	0	0	0	0	0	0	0	0	0
Manassas, City of	0	0	0	0	0	0	0	0	0	0
Manassas Park, City of	0	0	0	0	0	0	0	0	2	0
Dumfries, Town of	0	0	0	0	0	0	0	0	0	0
Herndon, Town of	0	0	0	0	0	0	0	0	0	0
Leesburg, Town of	0	0	0	0	2	0	0	0	0	0
Purcellville, Town of	0	0	3	0	3	0	0	1	0	0
Vienna, Town of	0	0	0	0	0	0	0	0	0	0
Total	**0**	**3**	**23**	**14**	**75**	**3**	**6**	**15**	**3**	**2**

Development Trends

A general analysis of land uses and development trends within the planning area is an important factor in formulating mitigation options that influence future land use decisions. In many cases, local development policies will greatly influence the degree of future vulnerability in communities across the region. The vulnerability of future buildings, infrastructure and critical facilities is a great concern to community leaders across the Northern Virginia region and, as discussed in Section 7: Capability Assessment, many of the day-to-day activities in local governments in the region are designed to deal with these challenges.

Land uses and development trends in the region are briefly discussed here and more so in the Section 3: Community Profile. Future plan updates will better address development trends and future vulnerability (to include the number and types of future buildings, infrastructure, and critical facilities located in the identified hazard areas) in more detail, in particular for hazards with a spatially defined hazard boundary, such as flood.

One of the most critical indicators to review in considering local development trends is population growth. The average rate of population change in the Northern Virginia region from 1990 to 2000 was 23.8 percent, which is significantly higher than the average growth rate for the state of Virginia during this same time period (14.4 percent). **Table 6.7** shows the breakdown of population growth rates, by jurisdiction. As can be seen in the table, Fairfax County experienced the highest growth in population while the Town of Purcellville experienced the highest growth rate based upon percent change.

Table 6.7
Population Growth Rates by Jurisdiction, 1990–2000

Jurisdiction	1990 Population	2000 Population	Population Change	Growth Rate
Arlington County	170,936	189,453	18,517	10.8%
Fairfax County	787,593	933,641	146,048	18.5%
Loudoun County	68,183	137,704	69,521	102.0%
Prince William County	211,404	275,876	64,472	30.5%
Alexandria, City of	111,183	128,283	17,100	15.4%
Fairfax, City of	19,622	21,498	1,876	9.6%
Falls Church, City of	9,578	10,377	799	8.3%
Manassas, City of	27,957	35,135	7,178	25.7%
Manassas Park, City of	6,734	10,290	3,556	52.8%
Dumfries, Town of	4,282	4,937	655	15.3%
Herndon, Town of	16,139	21,655	5,516	34.2%
Leesburg, Town of	16,202	28,311	12,109	74.7%
Purcellville, Town of	1,744	3,584	1,840	105.5%
Vienna, Town of	14,852	14,453	-399	-2.7%
Total	**1,466,409**	**1,815,197**	**348,788**	**23.8%**

Source: U.S. Census Bureau

Drought

Annualized Loss Estimate: $2,207,000
PRI Value: 2.3

No standardized methodology exists for estimating vulnerability to the drought hazard. As opposed to posing a direct threat to life and property, drought impact is primarily measured by its potential and actual economic effect on the agricultural sector as well as municipal and industrial water supplies. This economic effect can also be expected to affect related sectors such as wholesale and retail trade.

According to the U.S. Department of Commerce, Bureau of Economic Analysis, less than one percent of the Northern Virginia region's civilian workforce is involved in the farm or agriculture sector. Those that are tend to be most involved in hay production, which is grown primarily to feed livestock populations. Other vulnerable crops include corn, alfalfa and soybeans. According to the Virginia Farm Bureau, Loudoun County leads the Northern Virginia region with more than 1,000 active farms on 184,000 acres of farmland and close to 400 residents that call farming their principal occupation.

Lack of rainfall during drought conditions will affect water levels along the Potomac River, the main water source for the Northern Virginia region. Many of the major reservoirs serving the Northern Virginia region, including the Occoquan (Fairfax County) and the Beaverdam (Loudoun County) have experienced dangerously low levels in the past due to ongoing drought periods – most recently in 1999. During these periods, many locations are forced to begin water restrictions which could lead to potential economic impacts for the region. The most vulnerable residents during these dry periods are those who live in the more rural areas located away from the larger cities and populated suburbs of the region (many of whom draw their water supply from wells).

As discussed in the Hazard Analysis section, the entire Northern Virginia region is vulnerable to drought and historically suffers drought conditions between five and ten percent of the time. Since 1993, the region has been severely impacted by numerous instances of a long-term drought with damages totaling approximately $25 million (most of which was attributed to agricultural losses in Loudoun and Prince William counties). Prior to this period of record, very little historical data exists on past drought events.

Based upon recorded historical events and the applied loss estimation methodology, the regional annualized loss estimate for drought in the Northern Virginia region is $2,207,000. It should be noted that this estimate may be somewhat inflated due to the lack of historical drought data prior to 1993 to counterbalance the region's recent costly drought events.

According to the qualitative assessment performed using the PRI tool, the drought hazard scored a PRI value of **2.3** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.8** summarizes the risk levels assigned to each PRI category.

Table 6.8
Qualitative Assessment for Drought

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Possible	Limited	Moderate	More than 24 hours	More than one week

Extreme Temperatures

Annualized Loss Estimate: Negligible
PRI Value: 2.4

The greatest concern related to extreme temperatures is associated with its effect on human health. Extreme temperatures pose no direct threat to property, therefore future structural damages and associated dollar losses are expected to be negligible.

The most at-risk segment of the Northern Virginia region's population to extreme temperatures includes the elderly, the homeless and the ill. Healthy people who exercise outdoors during the summer months are considered to be at-risk as well, because they may underestimate the effects of extreme heat on their bodies (particularly in hot, humid weather when humidity effectively slows the evaporation of perspiration). For all of the at-risk groups identified above, potential health effects for extreme heat include dehydration, heat cramps, fainting, heat exhaustion and heat stroke. For extreme cold, hypothermia and frostbite are the primary health concerns, with homeless persons not seeking shelter identified as the most at-risk segment of the population.

According to the qualitative assessment performed using the PRI tool, the extreme temperatures hazard scored a PRI value of **2.4** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.9** summarizes the risk levels assigned to each PRI category.

Table 6.9
Qualitative Assessment for Extreme Temperatures

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Likely	Minor	Large	More than 24 hours	Less than one week

Flood

Annualized Loss Estimate: $3,912,000
PRI Value: 3.3

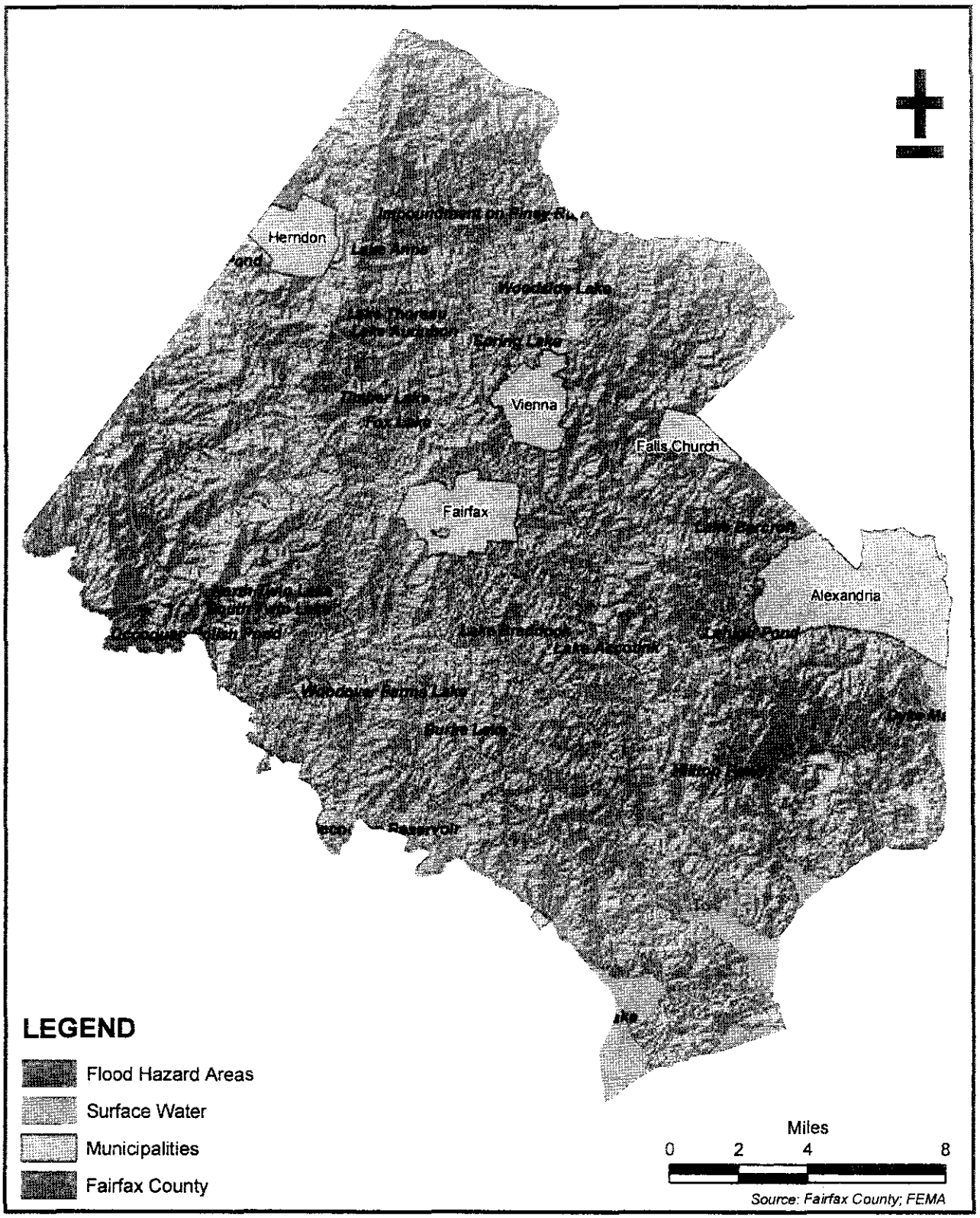
The vulnerability assessment for the flood hazard in the Northern Virginia region is principally based on the results of a detailed GIS analysis utilizing data layers provided by local jurisdictions and historical event information provided by the NCDC. Prior to completing the assessment various scenarios were run for determining annualized losses through FEMA's HAZUS^{MH} software, however the process yielded no meaningful data or useable results. It is expected that future enhancements to the flood module will improve NVRC's use of HAZUS^{MH} during future plan updates.

The most vulnerable properties to flooding in the Northern Virginia region are located in flood hazard areas identified by FEMA through the completion of detailed flood insurance studies. **Figures 6.6 – 6.16** illustrate the location of these areas for each jurisdiction based upon the most up-to-date digital floodplain data as provided by NVRC and participating jurisdictions (this excludes Arlington County, the City of Leesburg and the Town of Purcellville who do not currently have access to digital flood data, but will for future Plan updates). Where available, this digital flood data was overlaid with local parcel data and used to perform a GIS-based risk assessment for critical facilities (summarized previously in this section) and for determining the exposure (number and value) of potentially at-risk structures, as summarized below.

In order to further assess the Northern Virginia region's flood hazard vulnerability, a detailed GIS-based hazard assessment was completed for those jurisdictions that had submitted the necessary GIS data layers. This included digital flood data, tax parcel records (including year-built and assessed building value data) and building footprint data. With 100% of the requested data, it is possible to estimate total building exposure in the 100-year floodplain. **Table 6.10** summarizes the results of the assessment by jurisdiction to the maximum extent possible based upon data availability. As can be seen in the table, exposure data is limited for certain jurisdictions. Total building exposure may only be calculated for the City of Alexandria ($459 million) and the City of Fairfax ($123 million). It is expected that this assessment will be completed for all jurisdictions during future enhancements to the Plan.

Table 6.10
100-year Floodplain Exposure in the Northern Virginia Region (Zones A and AE)

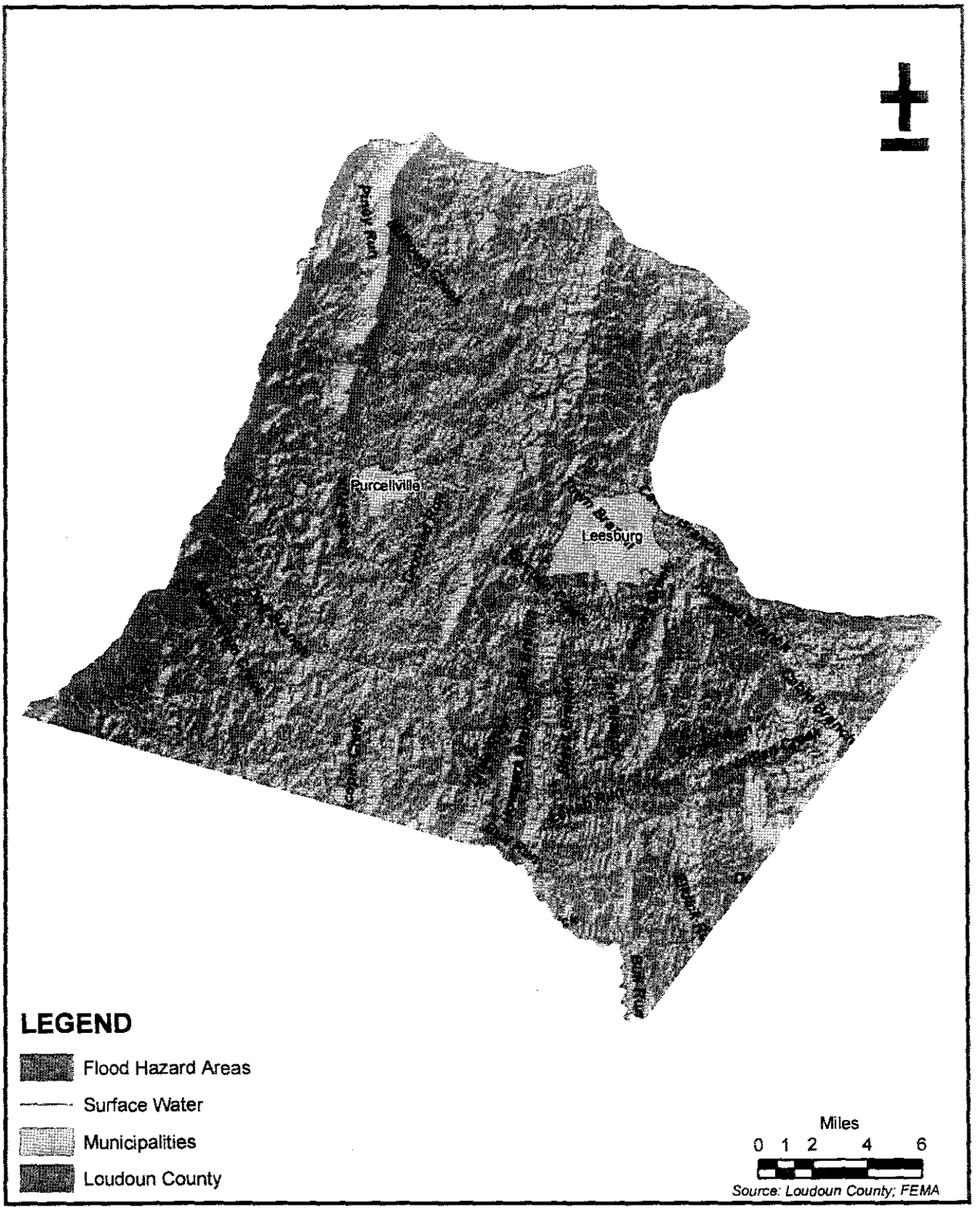
Jurisdiction	Total Number of Parcels	Number of Developed Parcels	Number of Vacant Parcels	Total Number of Structures	Assessed Building Value for Parcels with Structures	Number of Parcels with Pre-FIRM Structures	Assessed Building Value for Parcels with Pre-FIRM Structures
Arlington Co.	-	-	-	-	-	-	-
Fairfax Co.	19,607	14,819	4,788	1,908	-	-	-
Loudoun Co.	7,295	3,389	3,906	1,230	-	-	-
Prince William Co.	7,126	6,327	799	1,963	-	-	-
Alexandria	2,143	1,874	269	734	$1,157,643,000	511	$458,997,800
Fairfax (City)	864	760	104	191	$126,375,100	323	$123,223,700
Falls Church	231	193	38	179	-	-	-
Manassas	566	266	300	238	$97,327,300	-	-
Manassas Park	-	-	-	-	-	-	-
Dumfries	232	196	36	78	-	-	-
Herndon	145	113	32	17	-	-	-
Leesburg	-	-	-	-	-	-	-
Purcellville	-	-	-	-	-	-	-
Vienna	132	123	9	49	-	-	-
Total	**38,341**	**28,060**	**10,281**	**6,587**	**$1,381,345,400**	**834**	**$582,221,500**



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.6

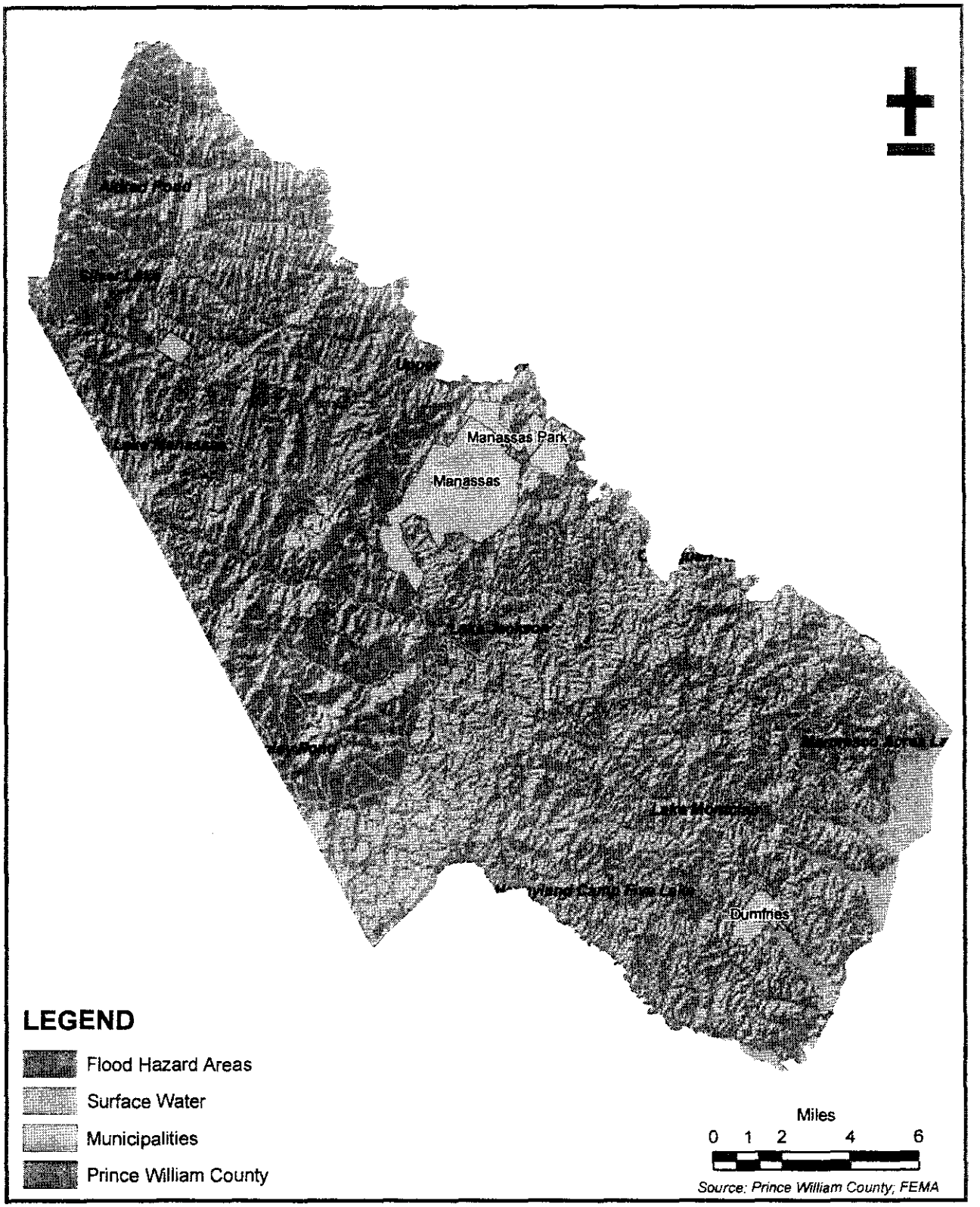
Flood Hazard Areas in Fairfax County



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.7

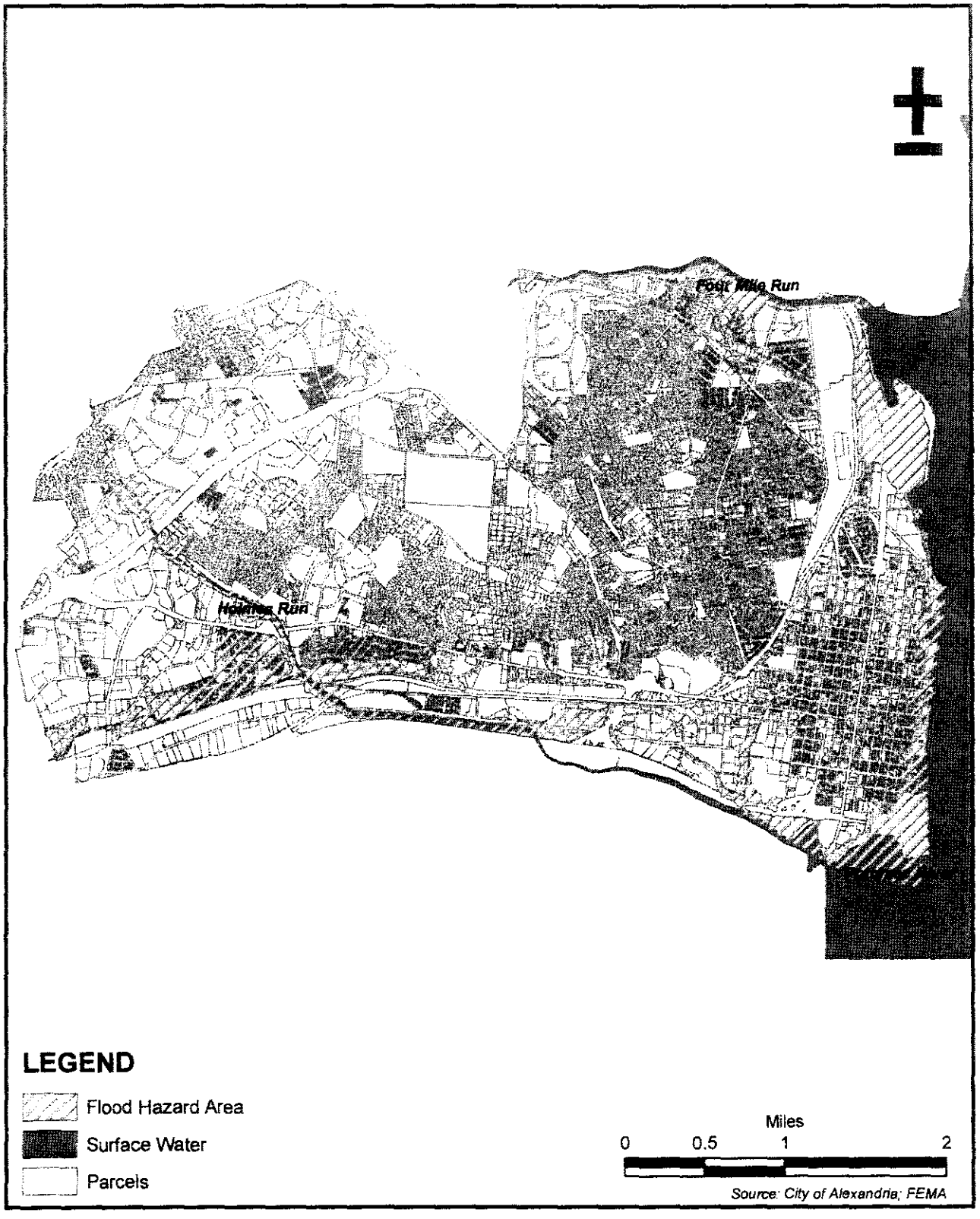
Flood Hazard Areas in Loudoun County



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.8

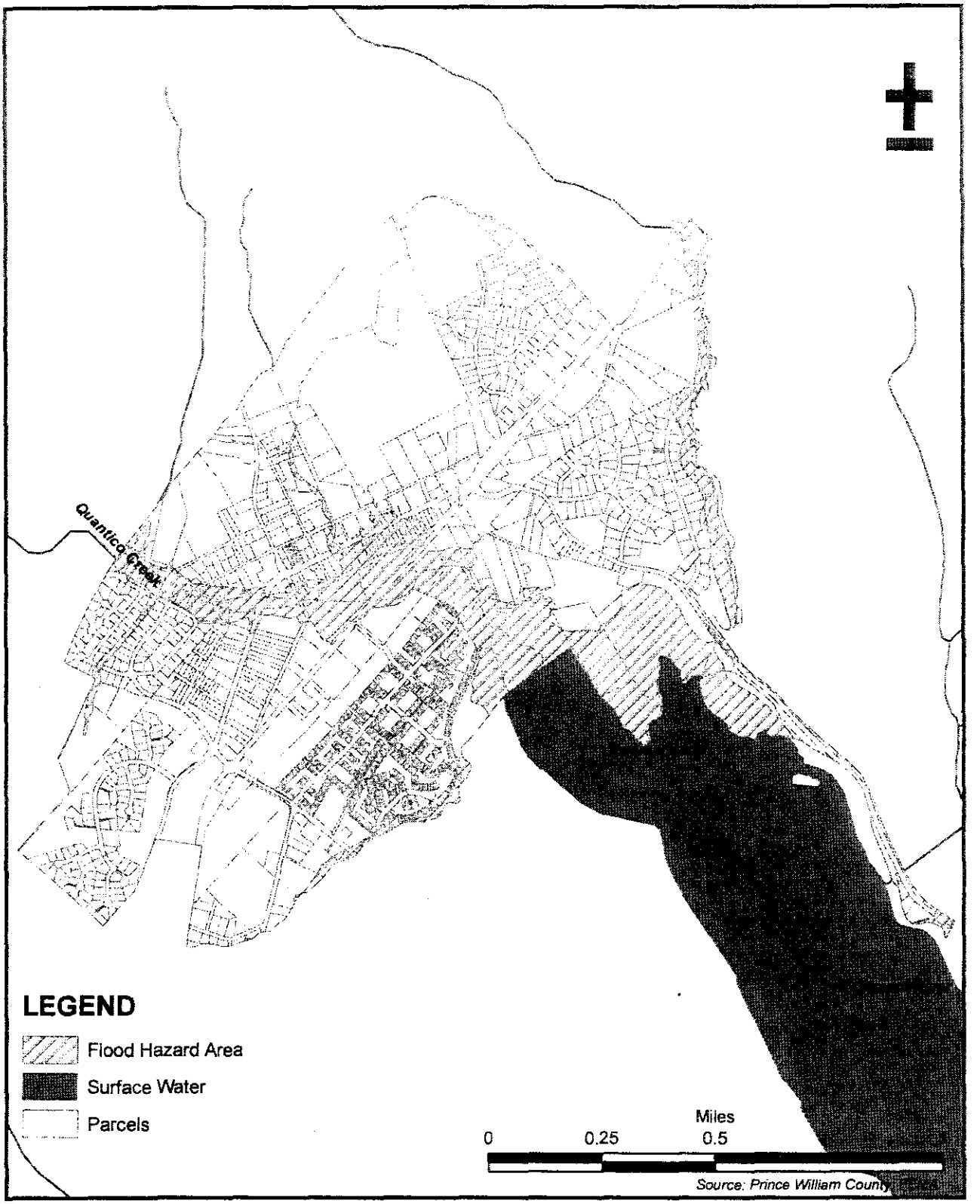
Flood Hazard Areas in Prince William County



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.9

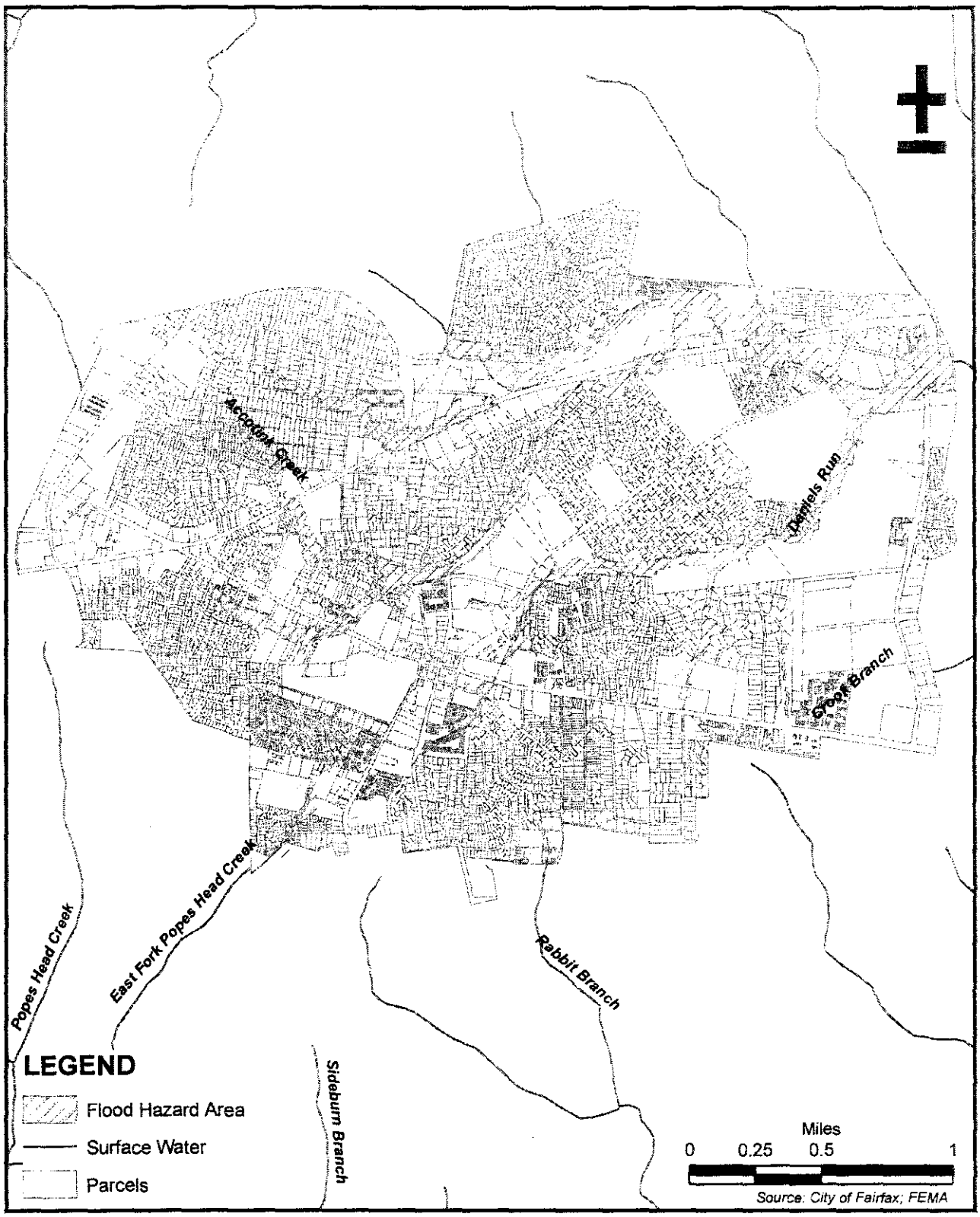
Flood Hazard Areas in Alexandria



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.10

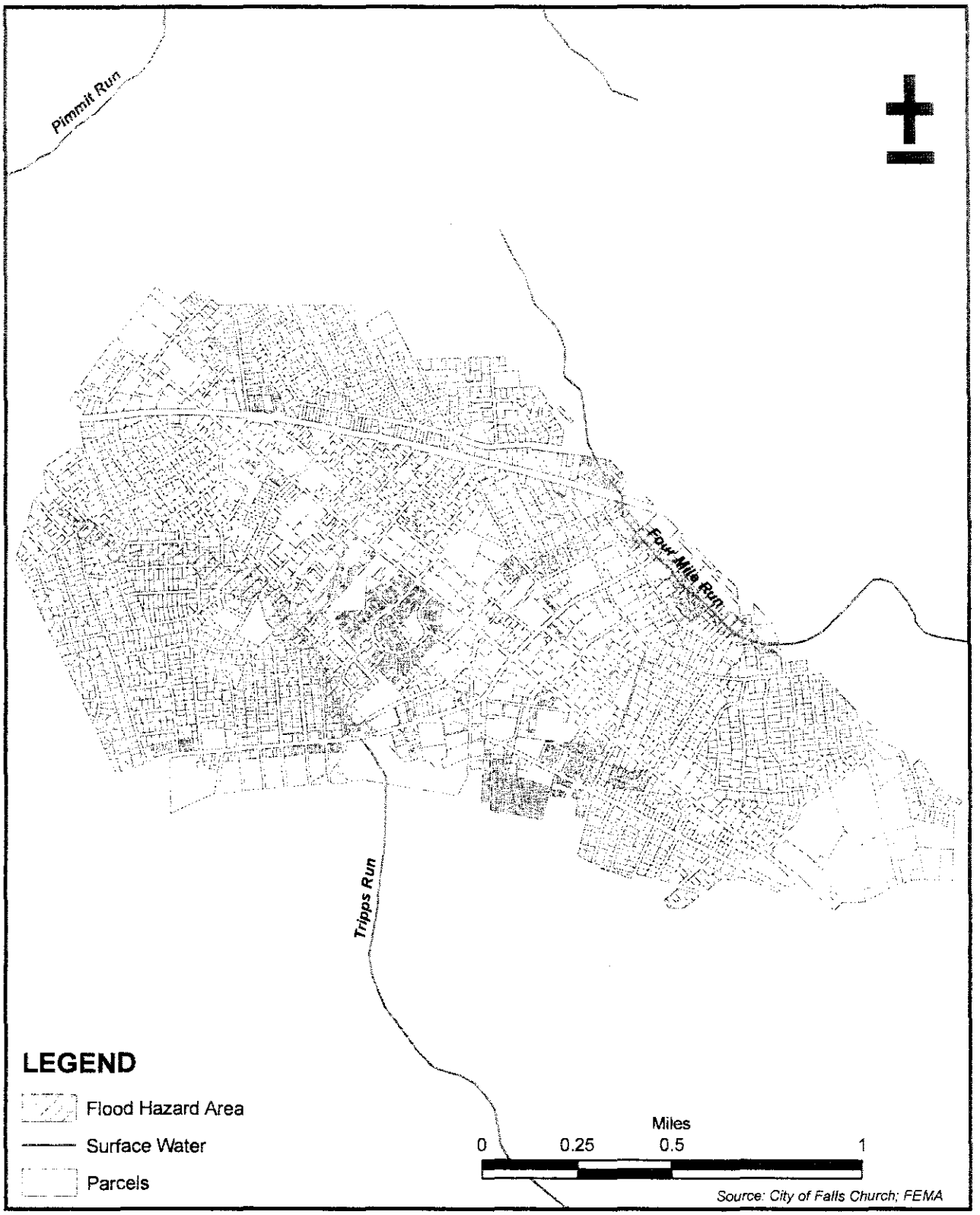
Flood Hazard Areas in Dumfries



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.11

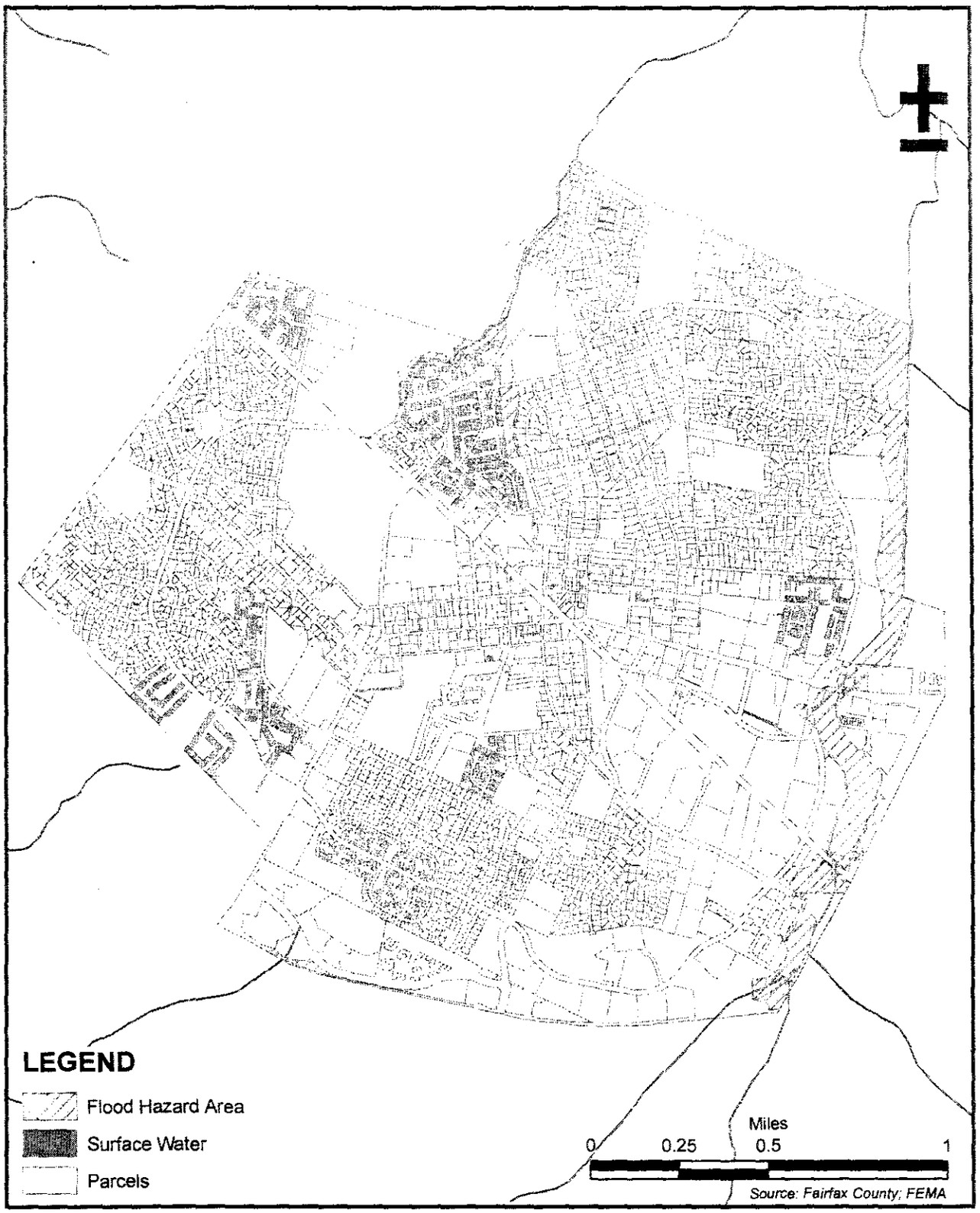
Flood Hazard Areas in Fairfax (City)



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.12

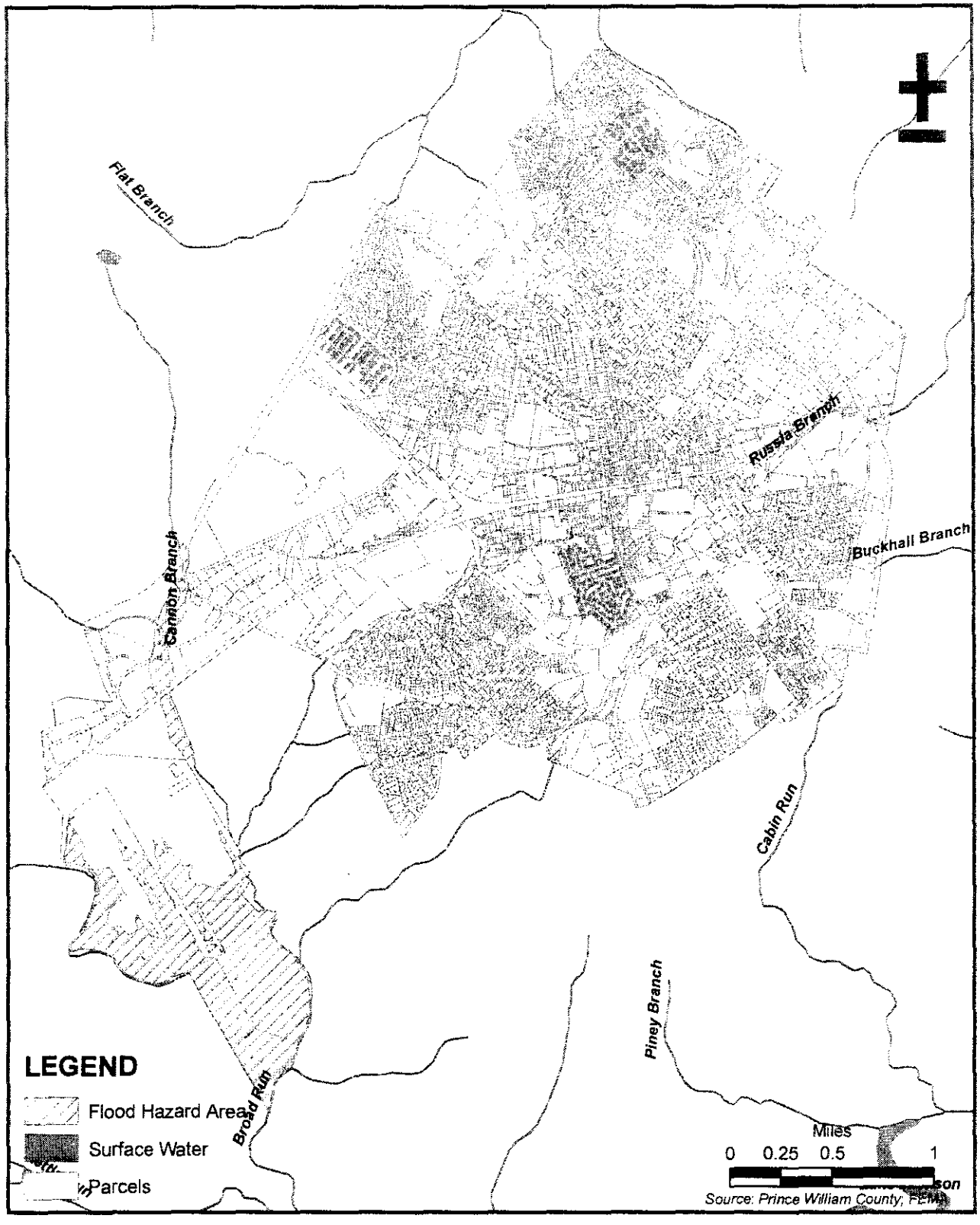
Flood Hazard Areas in Falls Church



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.13

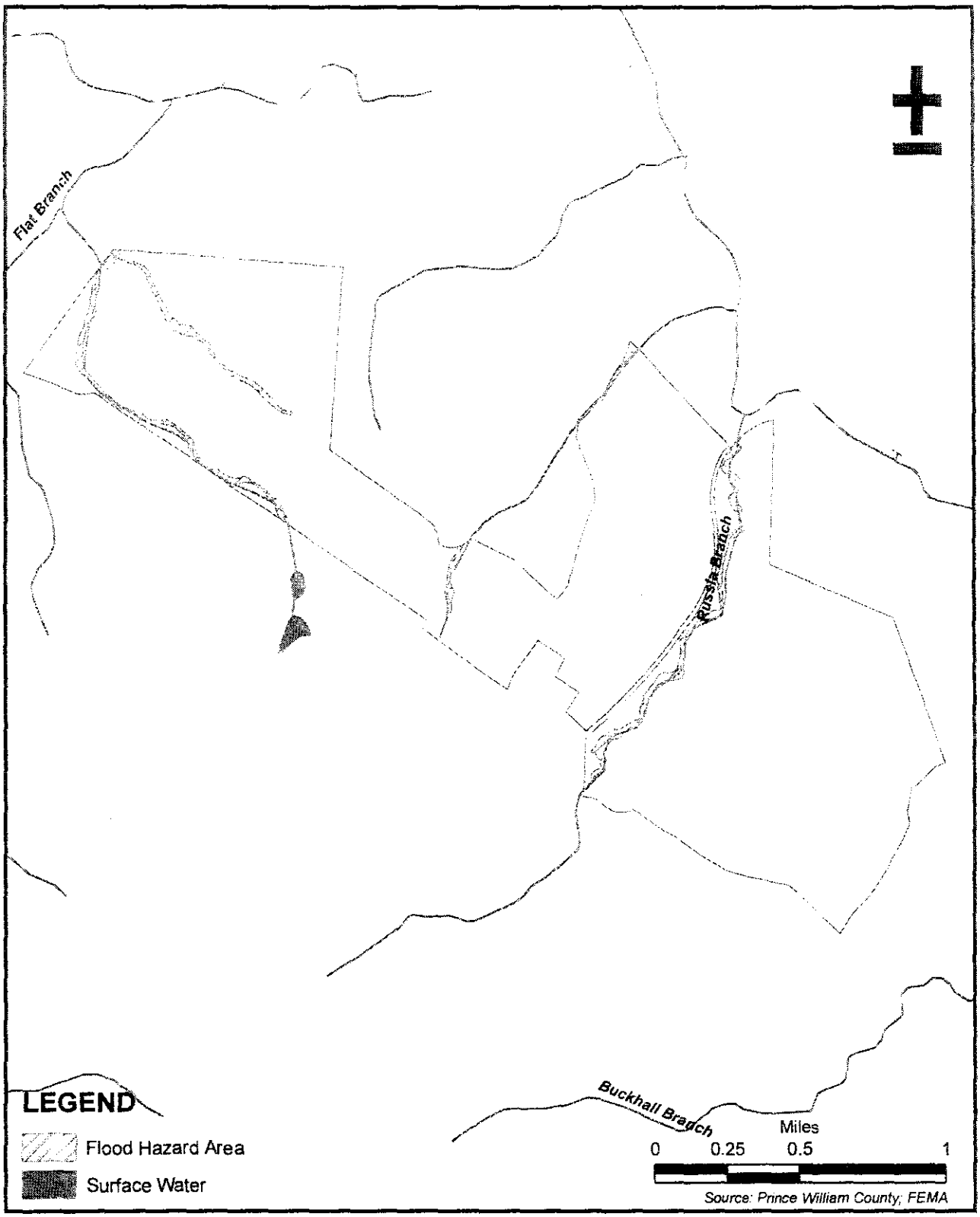
Flood Hazard Areas in Herndon



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.14

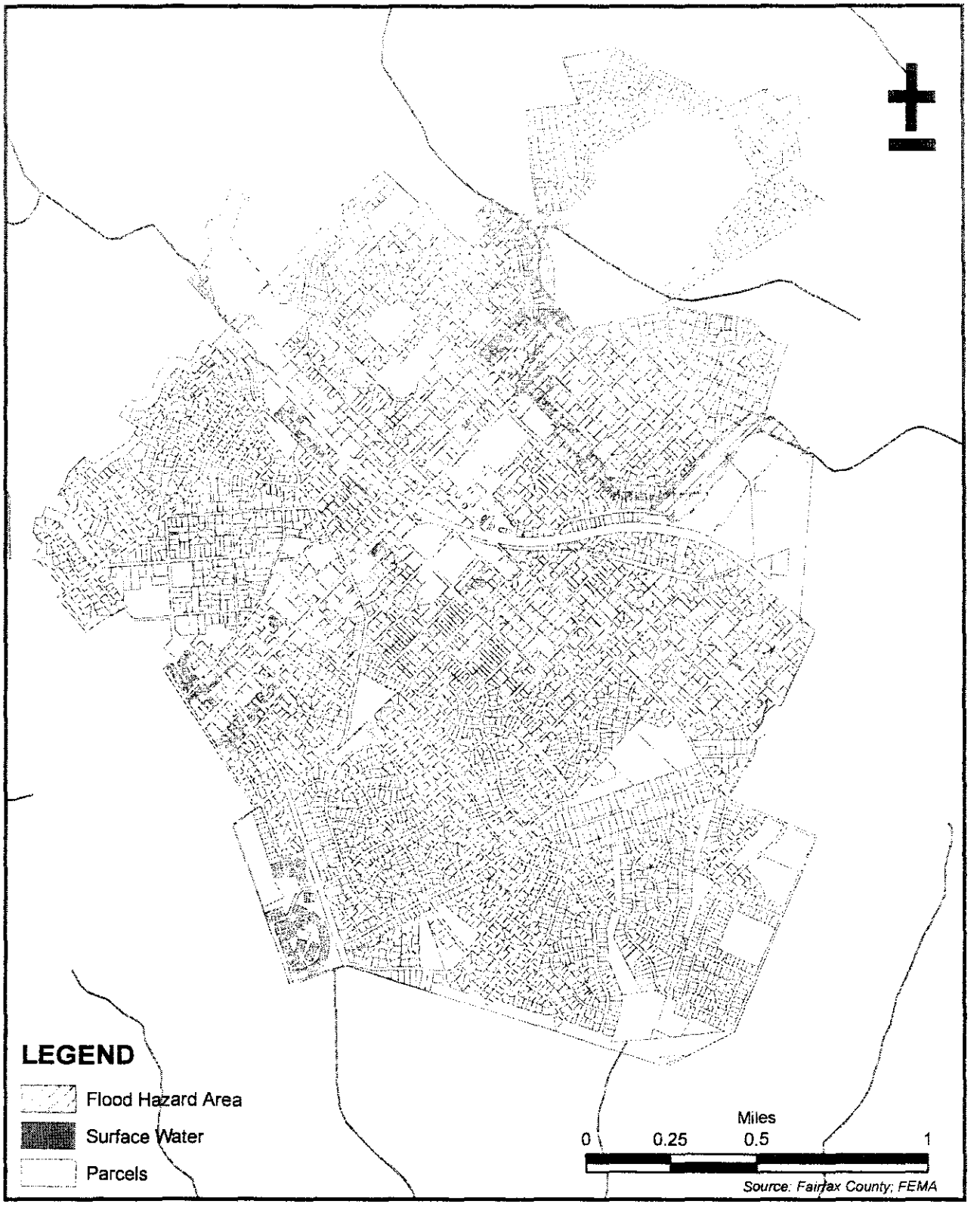
Flood Hazard Areas in Manassas



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.15

Flood Hazard Areas in Manassas Park



NORTHERN VIRGINIA REGIONAL HAZARD MITIGATION PLAN

Figure 6.16

Flood Hazard Areas in Vienna

National Flood Insurance Program Data

It is relevant to note in this discussion of flood hazard vulnerability certain vital statistics with regard to the National Flood Insurance Program (NFIP), as the number of flood insurance policies and insured property exposure provide indicators of how property owners perceive the local flood risk. More importantly, through further analysis, it may be possible to determine whether there is likely a significant number of at-risk properties not adequately covered through flood insurance. If this is the case, NVRC and its participating jurisdictions may wish to increase their general public awareness efforts to promote the availability of flood insurance through the NFIP.

As of December 31, 2003, there were a total of 5,398 flood insurance policies in the Northern Virginia region. These policies amounted to approximately $1.8 million in total premiums in-force and more than $798 million in total insurance coverage. **Table 6.11** shows the NFIP policy statistics for each of the participating jurisdictions of the Northern Virginia region.

Table 6.11
NFIP Policy Statistics for the Northern Virginia Region

Jurisdiction	NFIP Entry Date	Current Effective Map	Number of Policies	Total Premiums	Amount of Coverage
Arlington County	12/31/1976	05/03/1982	189	$76,619	$34,676,100
Fairfax County	01/07/1972	03/05/1990	2,426	$780,297	$363,189,800
Loudoun County	01/05/1978	07/05/2001	222	$115,489	$50,706,600
Prince William County	12/01/1981	01/05/1995	458	$215,360	$87,103,000
Alexandria, City of	05/08/1970	05/15/1991	1,634	$389,033	$192,650,700
Fairfax, City of	12/17/1971	02/19/2003	226	$74,603	$22,016,900
Falls Church, City of	02/03/1982	07/16/2004	59	$43,325	$11,997,300
Manassas, City of	01/03/1979	01/05/1995	60	$29,379	$10,480,900
Manassas Park, City of	09/29/1978	07/16/2003	11	$5,812	$1,375,700
Dumfries, Town of	05/15/1980	01/05/1995	5	$2,338	$1,017,500
Herndon, Town of	08/01/1979	08/01/1979	20	$9,128	$6,264,600
Leesburg, Town of	09/30/1982	07/05/2001	39	$16,017	$7,219,000
Purcellville, Town of	11/15/1989	07/05/2001	3	$997	$870,000
Vienna, Town of	02/03/1982	02/03/1982	46	$22,729	$9,250,500
Total			**5,398**	**$1,781,126**	**$798,818,600**

Source: Federal Emergency Management Agency

Repetitive Loss Properties

The identification of repetitive loss properties is an important element to conducting a local flood risk assessment, as the inherent characteristics of properties with multiple flood losses strongly suggest that they will be threatened by continual losses. Repetitive loss properties are also important to the NFIP, since structures that flood frequently put a strain on the National Flood Insurance Fund. Under the NFIP, FEMA defines a repetitive loss property as "any NFIP-insured property that, since 1978 and regardless of any change(s) of ownership during that period, has experienced: a) four or more paid flood losses; or b) two paid flood losses within a 10-year period that equal or exceed the current value of the insured property; or c) three or more paid losses that equal or exceed the current value of the insured property." A primary goal of FEMA is to reduce the numbers of structures that meet these criteria, whether through elevation, acquisition, relocation or a flood control project that lessens the potential for continual losses.

According to FEMA, there are currently 29 repetitive loss properties within the Northern Virginia region (listed in **Table 6.12**). The specific addresses of the properties are maintained by FEMA, NVRC and local jurisdictions, but are deliberately not included in this Plan as required by law.[8] It remains an objective of NVRC to encourage owners of repetitive loss properties throughout the region to apply for hazard mitigation funding to implement projects that reduce or eliminate the long-term risk of future flood damages. As can be seen in the table, three of the listed properties have reportedly already implemented a flood mitigation measure.

Table 6.12
NFIP Repetitive Loss Properties in the Northern Virginia Region

Property Locator #	Jurisdiction	Occupancy	Number of Insured Losses	Total Is Claims Paid	Mitigated?	Insured?
0014348	Alexandria, City of	Condo	2	$20,470	No	No
0082861	Alexandria, City of	Other Residential	3	$35,386	No	Yes
0109781	Alexandria, City of	Non-Residential	2	$6,115	No	No
0083776	Alexandria, City of	Non-Residential	3	$42,786	No	Yes
0014352	Alexandria, City of	Non-Residential	2	$27,145	**Yes**	No
0088164	Fairfax County	Single Family	3	$51,754	No	Yes
0125696	Fairfax County	Single Family	2	$33,491	No	Yes
0014357	Fairfax County	Single Family	3	$18,455	No	No
0045975	Fairfax County	Non-Residential	2	$29,225	No	No
0033210	Fairfax County	Single Family	2	$9,683	**Yes**	No
0049098	Loudoun County	Single Family	5	$207,983	No	Yes
0077317	Loudoun County	Single Family	3	$58,415	No	No
0080757	Loudoun County	Single Family	3	$28,430	No	Yes
0082431	Loudoun County	Single Family	2	$127,164	No	Yes
0033232	Loudoun County	Non-Residential	5	$24,651	No	Yes
0045317	Loudoun County	Single Family	4	$92,447	No	Yes
0077442	Loudoun County	Single Family	3	$47,584	No	Yes
0083665	Loudoun County	Single Family	2	$65,420	No	Yes
0089069	Loudoun County	Single Family	2	$58,949	No	No
0075334	Loudoun County	Single Family	3	$55,797	No	No
0036930	Loudoun County	Single Family	2	$10,514	**Yes**	No
0069172	Manassas, City of	Single Family	2	$7,977	No	No
0045281	Manassas, City of	Non-Residential	3	$20,727	No	No
0085411	Prince William County	Non-Residential	3	$184,025	No	Yes
0091034	Prince William County	Single Family	4	$56,673	No	Yes
0014362	Prince William County	Non-Residential	19	$789,535	No	No
0069171	Prince William County	Single Family	2	$32,078	No	Yes
0069173	Prince William County	Single Family	2	$7,765	No	No
0008602	Prince William County	Single Family	2	$15,401	No	Yes

Source: Federal Emergency Management Agency

[8] 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.

Findings

Since 1993, the Northern Virginia region has been severely impacted by numerous instances of a flooding with damages totaling approximately $44.3 million (of which more than $40 million is attributable to the effects of hurricanes and tropical storms). Prior to this period of record, very little historical damage data exists for past flood events. **Table 6.13** shows estimated annualized losses for each planning area based upon recorded historical events and the applied loss estimation methodology. The regional annualized loss estimate for the flood hazard in the Northern Virginia region is $3,912,000.

Table 6.13
Estimates of Potential Losses for Flood

Planning Area	Annualized Losses
1	$1,236,000
2	$1,240,000
3	$556,000
4	$880,000
Total	**$3,912,000**

According to the qualitative assessment performed using the PRI tool, the flood hazard scored a PRI value of **3.3** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.14** summarizes the risk levels assigned to each PRI category.

Table 6.14
Qualitative Assessment for Flood

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Highly Likely	Critical	Moderate	6 to 12 hours	Less than one week

Hurricanes and Tropical Storms

Annualized Loss Estimate: $33,723,000
PRI Value: 2.6

Historical evidence shows that the Northern Virginia region is vulnerable to damaging hurricane and tropical storms.[9] For purposes of this assessment, vulnerability is quantified for hurricane and tropical storm-force winds (sustained winds of greater 39 miles per hour). The effects of torrential rains, storm surge and tidal flooding have been included in the assessment for the flood hazard.

For the most part, the Northern Virginia region faces a uniform susceptibility to hurricanes and tropical storm winds. Though historical data and computer models indicate that Fairfax County may on average face higher wind speeds than other areas, the difference in peak gusts is not deemed significant (less than 20 miles per hour). However, based on the higher amount of residential and commercial exposure, Fairfax and Arlington counties are considered to be more vulnerable to these winds.

The most at-risk buildings to high wind events are assumed to include manufactured homes, along with residential structures that were built many years ago (due to probable deterioration and less stringent building code enforcement during original construction). **Table 6.15** summarizes this information for the Northern Virginia region, by county and city jurisdiction[10]. As can be seen, there are approximately 4,500 manufactured homes and more than 27,000 residential housing units built prior to 1940 in the Northern Virginia region. It then may be generally assumed that approximately 31,500 structures in the region (or roughly 5 percent of the residential building stock) will be more at-risk to high wind events. That being said, more detailed studies are required in order to better identify specific buildings or geographic areas within the region at higher risk to hurricane and tropical storm-force winds.

Table 6.15
At-Risk Residential Building Exposure in the Northern Virginia Region (2000)

Jurisdiction	Number of Manufactured Homes	Number of Homes Built Prior to 1940
Arlington County	93	9,950
Fairfax County	2,191	4,457
Loudoun County	261	3,551
Prince William County	1,726	1,491
Alexandria, City of	109*	6,666
Fairfax, City of	10	138
Falls Church, City of	5	408
Manassas, City of	173	341
Manassas Park, City of	7	15
Total	**4,575**	**27,017**

Source: U.S. Census Bureau

* Although the Census reports 109 manufactured homes in the City of Alexandria, it is believed these structures are located in unincorporated Fairfax County but maintain Alexandria addresses.

[9] Refer to Section 5: Hazard Analysis for detailed historical information.
[10] Data not available for separately for incorporated towns – but is included in the total for their respective counties.

Regional loss estimates for wind were developed based on probabilistic scenarios using HAZUS^{MH} (Level 1 analysis)[11] and the general building stock data described earlier in this section. **Table 6.16** shows estimated losses (building damages and contents losses) for 50, 100 and 500-year return periods by planning area. Based upon the potential wind-related losses for these scenarios, an annualized loss estimate of $33,723,000 was derived from the HAZUS^{MH} assessment for the entire Northern Virginia region.

Table 6.16
Estimates of Potential Losses for Hurricane and Tropical Storm-Force Winds

Planning Area	50-Year Event (61-89 mph)	100-Year Event (67-91 mph)	500-Year Event (79-113 mph)	Annualized Losses
1	$14,632,000	$53,955,000	$427,855,000	$5,549,000
2	$67,802,000	$225,398,000	$1,733,967,000	$21,895,000
3	$4,695,000	$18,795,000	$105,414,000	$1,523,000
4	$14,303,000	$46,923,000	$356,665,000	$4,756,000
Total	**$101,432,000**	**$345,071,000**	**$2,623,901,000**	**$33,723,000**

According to the qualitative assessment performed using the PRI tool, the hazard of hurricane and tropical storm-force winds scored a PRI value of **2.6** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.17** summarizes the risk levels assigned to each PRI category.

Table 6.17
Qualitative Assessment for Hurricane and Tropical Storm-Force Winds

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Possible	Critical	Large	More than 24 hours	Less than 24 hours

[11] A Level 1 analysis using HAZUS^{MH} yields a baseline estimate built upon national inventory databases and is considered by FEMA to be an appropriate method for assessing risk for DMA 2000 purposes.

Severe Thunderstorms

Annualized Loss Estimate: $1,110,000
PRI Value: 2.7

The Northern Virginia region faces uniform susceptibility to the effects of severe thunderstorms, including high winds, lightning and hail. However, based on historical storm data, Fairfax and Loudoun counties have experienced more damages caused by these events.

Similar to hurricane and tropical storm force-winds, the most at-risk buildings to thunderstorm winds are assumed to include manufactured homes and older residential structures (see discussion under *Hurricanes and Tropical Storms*). Another great concern for the Northern Virginia region with regard to thunderstorm winds is damage to electric power lines which regularly cause power outages for residents and businesses across the area. During past events, thunderstorm winds have downed trees across power lines, snapped utility poles and even blown down transformers resulting in widespread outages. Downed power lines create a dangerous threat to public safety; while difficult to quantify, long-term power outages can result in significant hardship for residents and major economic impacts for local businesses.

Lightning presents a significant threat to human safety and has historically caused injuries and death in the Northern Virginia region. Lightning has also been known to cause structural fires that can destroy property present further life/safety issues. According to the Virginia State Climatology Office, most lightning related deaths and injuries in Virginia have been males between the ages of 20 and 40 years old who were caught outdoors on golf courses, ball fields, near open water or under trees.

Hail, while not a major threat to human safety can be extremely destructive to crops and personal property (particularly vehicles as well as roofs, siding and windows of buildings). Most hail damage recorded for the Northern Virginia region has been in Fairfax and Loudoun counties, though all areas are considered to be equally at risk.

Since 1955, the Northern Virginia region has been impacted by nearly 1,000 severe thunderstorms totaling approximately $55 million in damages. **Table 6.18** shows estimated annualized losses for each planning area based upon recorded historical events and the applied loss estimation methodology. The regional annualized loss estimate for the severe thunderstorm hazard in the Northern Virginia region is $1,110,000.

Table 6.18
Estimates of Potential Losses for Severe Thunderstorms

Planning Area	Annualized Losses
1	$19,000
2	$785,000
3	$215,000
4	$91,000
Total	**$1,110,000**

According to the qualitative assessment performed using the PRI tool, the severe thunderstorm hazard scored a PRI value of **2.7** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.19** summarizes the risk levels assigned to each PRI category.

Table 6.19
Qualitative Assessment for Severe Thunderstorms

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Highly Likely	Limited	Small	Less than 6 hours	Less than 6 hours

Tornadoes

Annualized Loss Estimate: $731,000
PRI Value: 2.7

Based on historical occurrences, tornado events in the Northern Virginia region are more common in Loudoun County (almost half of the events recorded for the region took place in Loudoun County). However, it is expected that susceptibility for tornado occurrences is relatively uniform across the region. Historical data indicates that Fairfax County is by far the most vulnerable of the four counties in terms of property damages, fatalities and injuries. This is likely due to the more populated and developed nature of Fairfax County and its incorporated cities and towns.

Similar to hurricane and tropical storm force-winds, the most at-risk buildings to tornadoes are assumed to include manufactured homes and older residential structures (see discussion under *Hurricanes and Tropical Storms*). Even small F1 tornadoes can cause severe damage to these buildings. For more intense tornadoes (F2 and higher), all buildings are considered at-risk with the exception of those specifically built to withstand wind speeds of more than 120-150 miles per hour (such as designated shelters, emergency operations centers, etc.).

Since 1955, the Northern Virginia region has been impacted by 39 tornadoes totaling approximately $40 million in damages. **Table 6.20** shows estimated annualized losses for each planning area based upon recorded historical events and the applied loss estimation methodology. The regional annualized loss estimate for the tornado hazard in the Northern Virginia region is $731,000.

Table 6.20
Estimates of Potential Losses for Tornadoes

Planning Area	Annualized Losses
1	$20,000
2	$632,000
3	$28,000
4	$51,000
Total	**$731,000**

According to the qualitative assessment performed using the PRI tool, the tornado hazard scored a PRI value of **2.7** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.21** summarizes the risk levels assigned to each PRI category.

Table 6.21
Qualitative Assessment for Tornadoes

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Likely	Critical	Small	Less than 6 hours	Less than 6 hours

Wildfire

Annualized Loss Estimate: $25,000
PRI Value: 2.6

Based on the number of historical occurrences, wildfires are very prevalent events in the Northern Virginia region. These events however are usually contained to very small areas (averaging less than four acres) and have caused minimal damages to property due to strong fire response and suppression capabilities. In fact, according to recent Virginia Department of Forestry (VDOF) statistics, an average of more than $1 million in damages per year has been avoided in the Northern Virginia region thanks to state and local fire suppression efforts.

As demonstrated in the Hazard Analysis section, most of the wildfire risk in the Northern Virginia region is located in areas of Loudoun and Prince William counties. Historically, wildfires have been larger and caused more damages in these counties mainly due to not only increased vegetative fuel loads but also because the areas more sparsely settled and have less rapid fire response capabilities. The most at-risk properties within these areas are considered to be those structures located along the wildland-urban interface, defined by the National Wildfire Coordinating Group[12] as "the line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels." Structures with combustible roofs and less than 30 feet of cleared defensible space are particularly at risk.

According to VDOF statistics, Virginia has more than 4,000 woodland home communities. These areas are defined by VDOF as "clusters of homes located along forested areas at the wildland-urban interface that could possibly be damaged during a nearby wildfire incident." In the Northern Virginia region, there are 91 woodland home communities, all of which are located in Loudoun (21) and Prince William (70) counties[13]. **Table 6.22** lists the number of woodland home communities by planning area for the Northern Virginia region that are located in areas identified as being either high or moderate risk for wildfires. **Figure 6.17** shows the location of these woodland home communities in relation to the identified wildfire hazard areas. More information on these communities is readily available through the VDOF.

Table 6.22
At-Risk Woodland Communities in the Northern Virginia Region

Planning Area	High Risk Communities	Moderate Risk Communities
1	0	0
2	0	0
3	7	13
4	36	27
Total	**43**	**40**

Source: VDOF

Between 1995 and 2001, the VDOF recorded 86 wildfire events in the Northern Virginia region totaling approximately $175,000 in damages. **Table 6.23** shows estimated annualized losses for each planning

[12] 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.
[13] A current listing of Virginia's woodland home communities can be made available by VDOF upon request.

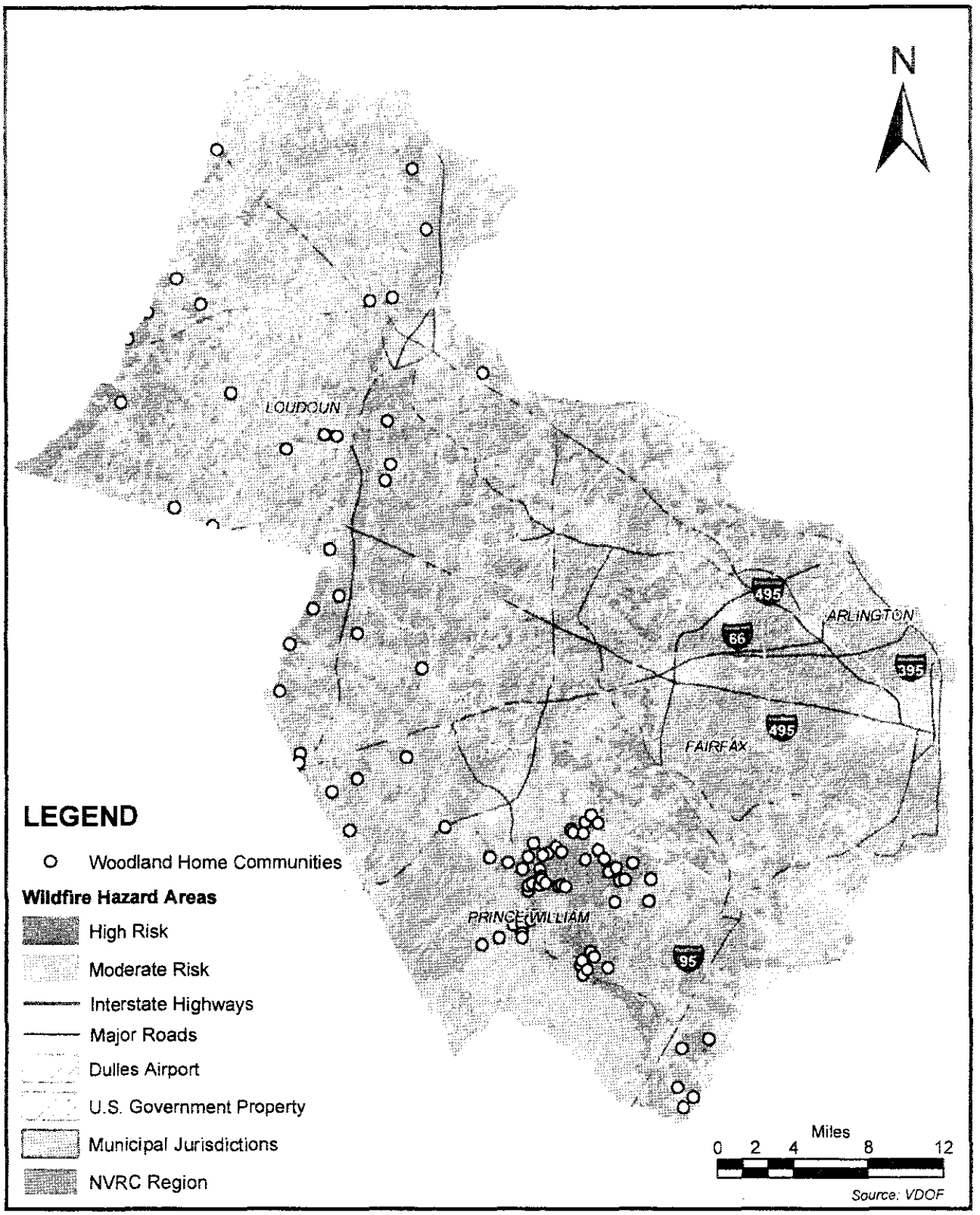


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Figure 6.17

Woodland Home Communities / Wildfire Hazard Areas

area based upon recorded historical events and the applied loss estimation methodology. The regional annualized loss estimate for the wildfire hazard in the Northern Virginia region is $25,000.

Table 6.23
Estimates of Potential Losses for Wildfire

Planning Area	Annualized Losses
1	$0
2	$0
3	$23,000
4	$2,000
Total	**$25,000**

According to the qualitative assessment performed using the PRI tool, the wildfire hazard scored a PRI value of **2.6** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.24** summarizes the risk levels assigned to each PRI category.

Table 6.24
Qualitative Assessment for Wildfire

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Highly Likely	Minor	Small	Less than 6 hours	Less than one week

Winter Storms

Annualized Loss Estimate: $109,000
PRI Value: 3.0

Losses associated with winter storms are typically related to snow removal and business interruption, although power failure is also a significant secondary hazard commonly associated with winter storms, and particularly ice events. In addition to the impacts on transportation, power transmission and communications, severe winter storms in the Northern Virginia region have at times cause severe property damage due to roof collapses. According to FEMA, most injuries and fatalities related to winter storms are caused by vehicle accidents and hypothermia.

The entire Northern Virginia region is equally susceptible to winter storms, and based on historical records each of the four counties has experienced similar numbers of events and levels of damage. Due to higher residential and commercial densities, Arlington and Fairfax counties may be more severely impacted by winter storms in terms of loss of interruption to service (transportation, communication, etc.) but aren't considered significantly more vulnerable.

The Northern Virginia region has been impacted by hundreds of severe winter storms. According to the NCDC, the region has suffered an estimated $1.2 million in property damages caused by winter storms since 1993. **Table 6.25** shows estimated annualized losses for each planning area based upon these recorded historical events and the applied loss estimation methodology. The regional annualized loss estimate for the winter storm hazard in the Northern Virginia region is $731,000.

Table 6.25
Estimates of Potential Losses for Winter Storms

Planning Area	Annualized Losses
1	$27,000
2	$27,000
3	$28,000
4	$27,000
Total	**$109,000**

According to the qualitative assessment performed using the PRI tool, the winter storm hazard scored a PRI value of **3.0** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.26** summarizes the risk levels assigned to each PRI category.

Table 6.26
Qualitative Assessment for Winter Storms

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Highly Likely	Limited	Large	More than 24 hours	Less than one week

Erosion

Annualized Loss Estimate: Negligible
PRI Value: 1.9

Erosion vulnerability for the region is difficult to determine because there are no historical records for previous occurrences of erosion events. The Northern Virginia region's vulnerability to erosion is limited to those immediate areas along rivers, creeks and streams and to areas of loose soils with steep slopes. In most cases where erosion poses an imminent threat to property, erosion control techniques are typically applied before damages may occur. Therefore, future structural damages caused by long-term erosion and associated dollar losses are expected to be negligible.

As discussed in the Hazard Analysis section, NVRC prepared a study entitled "*Tidal Shoreline Erosion in Northern Virginia*" which discusses the erosion situation for various segments of the shoreline in the Northern Virginia region as well as identifies the locations of "priority" erosion concern. This publication is hereby incorporated by reference, as will future updates to shoreline erosion studies in the Northern Virginia region.

According to the qualitative assessment performed using the PRI tool, the erosion hazard scored a PRI value of **1.9** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.27** summarizes the risk levels assigned to each PRI category.

Table 6.27
Qualitative Assessment for Erosion

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Likely	Minor	Negligible	More than 24 hours	More than one week

Future updates to this Plan will attempt to address erosion vulnerability in greater detail, if warranted.

Earthquakes

Annualized Loss Estimate: $341,000
PRI Value: 1.9

The recurrence interval for significant earthquake events in the Northern Virginia region is very low; however, the potential impact of a major seismic event along the Eastern Tennessee or Central Virginia seismic zone could be moderately destructive. Due to the area's relatively low seismic risk, buildings and infrastructure throughout the region are not designed to withstand major ground shaking events. This means of course that if such events do occur, while unlikely, the losses could likely be substantial.

Countywide loss estimates for earthquake were developed based on probabilistic scenarios using HAZUS^{MH} (Level 1 analysis)[14] and the general building stock data described earlier in this section. In determining annualized loss estimates, HAZUS^{MH} employs a probabilistic hazard approach that accounts for the contribution of earthquakes of varying magnitudes and locations over return periods of 100, 250, 500, 750, 1,000, 1,500, 2,000 and 2,500 years. This approach results in predictive damage modeling that takes into account events that are highly unlikely yet certainly within the realm of possibility.

Table 6.28 shows estimated losses (building damages and contents losses) for 500, 1,000 and 2,500-year return periods[15] by planning area. Based upon the potential earthquake losses for these scenarios, an annualized loss estimate of $341,000 was derived from the HAZUS^{MH} assessment for the entire Northern Virginia region.

Table 6.28
Estimates of Potential Losses for Earthquakes

Planning Area	500-Year Event	1,000-Year Event	2,500-Year Event	Annualized Losses
1	$12,171,000	$37,673,000	$139,293,000	$32,000
2	$73,295,000	$236,459,000	$849,044,000	$218,000
3	$12,349,000	$39,305,000	$141,866,000	$33,000
4	$20,085,000	$64,809,000	$226,090,000	$58,000
Total	**$117,900,000**	**$378,246,000**	**$1,358,293,000**	**$341,000**

According to the qualitative assessment performed using the PRI tool, the earthquake hazards scored a PRI value of **1.9** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.29** summarizes the risk levels assigned to each PRI category.

Table 6.29
Qualitative Assessment for Earthquakes

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Unlikely	Minor	Large	Less than 6 hours	Less than 6 hours

[14] A Level 1 analysis using HAZUS^{MH} yields a baseline estimate built upon national inventory databases and is considered by FEMA to be an appropriate method for assessing risk for DMA 2000 purposes.
[15] Loss estimates do not take into account the potential for collateral hazards such as liquefaction, fire or landslide.

Sinkholes

Annualized Loss Estimate: Negligible
PRI Value: 1.5

As discussed in the Hazard Analysis section, sinkholes are relatively uncommon events in the Northern Virginia region. The existing soil types are not conducive to creating natural sinkholes, and those that do occur are related to soil piping or the dissolution of sparse carbonate rock and typically cause very little damage. There are no known sources of sinkhole probability data for the region and no record of historical incidences causing property damages. Therefore, future damages caused by sinkholes and associated dollar losses are expected to be negligible.

According to the qualitative assessment performed using the PRI tool, the sinkhole hazard scored a PRI value of **1.5** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.30** summarizes the risk levels assigned to each PRI category.

Table 6.30
Qualitative Assessment for Sinkholes

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Possible	Minor	Negligible	6 to 12 hours	Less than 6 hours

Future updates to this Plan will attempt to address sinkhole vulnerability in greater detail, if warranted.

Landslides

Annualized Loss Estimate: Negligible
PRI Value: 1.6

As discussed in the Hazard Analysis section, landslides are relatively uncommon events in the Northern Virginia region. Minor landslide events are possible and have been known to occur in localized, steep-sloped areas of the Northern Virginia region during extremely wet conditions. Though there are no documented occurrences, landslides are more likely to occur in western portions of Loudoun County than other areas of the region. Small landslides and minor subsidence issues have also been recorded in eastern areas of Fairfax County, possibly due to the presence of marine clay, though no major damages have ever been recorded. Due to the lack of any historical landslide damage data, future damages caused by landslides and associated dollar losses are expected to be negligible.

According to the qualitative assessment performed using the PRI tool, the landslide hazard scored a PRI value of **1.5** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.31** summarizes the risk levels assigned to each PRI category.

Table 6.31
Qualitative Assessment for Landslide

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Possible	Minor	Small	12 to 24 hours	Less than 6 hours

Future updates to this Plan will attempt to address landslide vulnerability in greater detail, if warranted.

Dam Failure

Annualized Loss Estimate: Negligible
PRI Value: 2.3

Dam failure is considered unlikely in the Northern Virginia region due to existing safety measures and rigorous inspection reporting programs. The Virginia Department of Conservation and Recreation (DCR) requires specific operation and maintenance procedures, as well as routine inspections and regularly updated emergency action plans for each of the major and state-regulated dams in the Northern Virginia region. Therefore, future damages caused by dam failure and associated dollar losses are expected to be negligible – though the danger remains real and will continue to receive critical attention through the DCR's Dam Safety and Floodplain Management Program.

As discussed in the Hazard Analysis section, there are six dams in the region classified as "high" hazard, all located in Fairfax and Prince William counties. Again, these hazard classifications are not related to the physical condition or structural integrity of the dam (nor the probability of its failure) but strictly to the potential for adverse downstream effects if the dam were to fail. There are no dam failure inundation maps available for the Northern Virginia region, making it difficult to quantify the amount of at-risk properties to such an event.

Only two of the major dams classified as high hazard have a drainage area of more than 20 square miles (the Upper Occoquan dam in Fairfax County and the T. Nelson Elliot dam in Prince William County), making the possibility of a catastrophic dam failure event elsewhere highly unlikely in the region. The Northern Virginia region is likely more prone to intentional water releases by dam operators immediately prior to or during major rainfall events, though in such cases the releases are coordinated with local emergency management officials to minimize potential risks to people and property.

According to the qualitative assessment performed using the PRI tool, the dam failure hazard scored a PRI value of **2.3** (from a scale of 0 to 4, with 4 being the highest risk level). **Table 6.32** summarizes the risk levels assigned to each PRI category.

Table 6.32
Qualitative Assessment for Dam Failure

	Probability	Impact	Spatial Extent	Warning Time	Duration
Risk Level	Unlikely	Critical	Small	Less than 6 hours	Less than one week

Future updates to this Plan will attempt to address dam failure vulnerability in greater detail, if warranted. This may include a detailed analysis of properties directly downstream of the high hazard dams in order to better determine the amount of people and value of properties located in potential inundation zones and thereby vulnerable to dam failure.

Unique Risks for Local Jurisdictions

In addition to the hazard analysis and vulnerability assessment completed for the Northern Virginia region as a whole, officials from each of the participating local jurisdictions were asked to provide information on any unique hazard risks that were omitted or not satisfactorily addressed during the drafting stage of the Plan and through a survey instrument distributed at the Mitigation Strategy Workshop.

In response to this request, officials from three jurisdictions responded with specific concerns. These responses are summarized in **Table 6.33**.

Table 6.33
Unique Risks and Hazard Concerns

Jurisdiction	Unique Risk / Hazard Concern
City of Fairfax	A large petroleum tank farm facility located in the city, and potentially vulnerable to manmade and natural hazards including lightning, high winds and flooding.
City of Manassas	The airport (particularly areas around Broad Run) are prone to frequent flooding. A nearby mobile home park (approximately 200 units) is identified as presenting a unique risk, in addition to approximately 10 commercial buildings and the air traffic control tower.
Prince William County	Pipeline rupture and train derailment identified as unique risks.

No other local jurisdiction identified unique hazards of concern beyond those already covered under this Plan.

Conclusions on Hazard Risk

The vulnerability assessment performed for the Northern Virginia region resulted in significant findings that allow the Mitigation Advisory Committee to prioritize hazards risks and its proposed hazard mitigation strategies. Prior to assigning conclusive risk levels for each hazard, the Mitigation Advisory Committee reviewed the results of quantitative and qualitative assessments shown in the following tables.

Table 6.34 summarizes the degree of risk assigned to each category for all identified hazards in the Northern Virginia region based on the application of the PRI tool. Assigned risk levels were based on historical and anecdotal data, as well as input from the Mitigation Advisory Committee. The results were then used in calculating PRI values and making conclusions for the qualitative assessment.

Table 6.34
Summary of Qualitative Assessment

Hazard	Category / Degree of Risk				
	Probability	Impact	Spatial Extent	Warning Time	Duration
Drought	Possible	Limited	Moderate	More than 24 hours	More than one week
Extreme Temperatures	Likely	Minor	Large	More than 24 hours	Less than one week
Flood	Highly Likely	Critical	Moderate	6 to 12 hours	Less than one week
Hurricanes and Tropical Storms	Possible	Critical	Large	More than 24 hours	Less than 24 hours
Severe Thunderstorms	Highly Likely	Limited	Small	Less than 6 hours	Less than 6 hours
Tornadoes	Likely	Critical	Small	Less than 6 hours	Less than 6 hours
Wildfire	Highly Likely	Minor	Small	Less than 6 hours	Less than one week
Winter Storms	Highly Likely	Limited	Large	More than 24 hours	Less than one week
Erosion	Likely	Minor	Negligible	More than 24 hours	More than one week
Earthquakes	Unlikely	Minor	Large	Less than 6 hours	Less than 6 hours
Sinkholes	Possible	Minor	Negligible	6 to 12 hours	Less than 6 hours
Landslides	Possible	Minor	Small	12 to 24 hours	Less than 6 hours
Dam Failure	Unlikely	Critical	Small	Less than 6 hours	Less than one week

Table 6.35 summarizes the annualized loss estimates that were generated for the applicable hazards based on the quantitative assessment. **Table 6.36** summarizes the PRI values determined for each hazard based on the qualitative assessment. The results and comparisons of both assessments helped the Mitigation Advisory Committee in determining the final conclusions on overall hazard risk for the Northern Virginia region.

Table 6.35
Annualized Loss Estimates

Hazard	Annualized Loss
Hurricanes and Tropical Storms	**$33,723,000**
Flood	**$3,912,000**
Drought	**$2,207,000**
Severe Thunderstorms	**$1,110,000**
Tornadoes	**$731,000**
Earthquakes	**$341,000**
Winter Storms	**$109,000**
Wildfire	**$25,000**
Extreme Temperatures	**Negligible**
Erosion	**Negligible**
Sinkholes	**Negligible**
Landslides	**Negligible**
Dam Failure	**Negligible**

Table 6.36
Priority Risk Index (PRI) Values

Hazard	PRI Value
Flood	**3.3**
Winter Storms	**3.0**
Severe Thunderstorms	**2.7**
Tornadoes	**2.7**
Hurricanes and Tropical Storms	**2.6**
Wildfire	**2.6**
Extreme Temperatures	**2.4**
Drought	**2.3**
Dam Failure	**2.3**
Erosion	**1.9**
Earthquakes	**1.9**
Landslides	**1.6**
Sinkholes	**1.5**

The conclusions drawn from the qualitative and quantitative assessments, combined with final determinations from the Mitigation Advisory Committee, were fitted into three categories for a final summary of hazard risk for the Northern Virginia region based on High, Moderate or Low designations (**Table 6.37**). It should be noted that although some hazards are classified as posing Low risk, their occurrence of varying or unprecedented magnitudes is still possible and will continue to be reevaluated during future updates of this Plan.

Table 6.37
Conclusions on Hazard Risk for the Northern Virginia Region

HIGH RISK	Flood Severe Thunderstorms Tornadoes Winter Storms
MODERATE RISK	Hurricanes and Tropical Storms Drought Wildfire
LOW RISK	Earthquakes Extreme Temperatures Dam Failure Erosion Landslides Sinkholes

CAPABILITY ASSESSMENT

This section of the Plan discusses the capability of the participating local jurisdictions to implement hazard mitigation activities. It consists of the following six subsections:

- What is a Capability Assessment?
- Conducting the Capability Assessment
- Capability Assessment Findings
- Conclusions on Local Capability
- Linking the Capability Assessment with the Risk Assessment and the Mitigation Strategy
- Plan Review Matrix

What is a Capability Assessment?

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.

The capability assessment completed for the Northern Virginia region's local governments serves as a critical planning step and an integral part of the foundation for designing an effective multi-jurisdictional hazard mitigation strategy. Coupled with the *Risk Assessment*, the *Capability Assessment* helps identify and target meaningful mitigation actions for incorporation in the *Mitigation Strategy* portion of the Hazard Mitigation Plan. It not only helps establish the goals and objectives for local governments to pursue under this Plan, but also ensures that those goals and objectives are realistically achievable under given local conditions.

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[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)).

Conducting the Capability Assessment

In order to facilitate the inventory and analysis of local government capabilities throughout the Northern Virginia region, a detailed *Capability Assessment Survey*[2] was distributed. The survey questionnaire, which was 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 and/or hinder the community's ability to implement hazard mitigation actions. Other indicators included information related to each jurisdiction's fiscal, administrative and technical capabilities, such as access to local budgetary and personnel resources for mitigation purposes. Survey respondents were also asked to comment on the current political climate in their jurisdiction with respect to hazard mitigation, an important consideration for any local planning or decision making process.

At a minimum survey results provide 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. In completing the survey local officials were also required to conduct a self-assessment of their jurisdiction's specific capabilities. The survey instrument thereby not only helps 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.

The information provided by participating jurisdictions in response to the survey questionnaire was incorporated into a database for further analysis. A general scoring methodology[3] was then applied to quantify and rank each jurisdiction's overall capability relative to one another. According to the scoring system, each capability indicator was assigned a point value based on its relevance to hazard mitigation. Additional points were added based on each jurisdiction's self-assessment of their own planning and regulatory capability, administrative and technical capability, fiscal capability and political capability.

A total score and general capability rating of "High," "Moderate" or "Limited" was determined for each jurisdiction according to the total number of points received. These classifications are designed to provide nothing more than a general assessment of each individual jurisdiction's local capability relative to one another using a consistent methodology. In combination with the narrative responses provided by local officials, the results of this multi-jurisdictional capability assessment lend critical information for developing an effective and meaningful mitigation strategy.

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 Northern Virginia Regional Commission upon request.

Planning and Regulatory Capability

Planning and regulatory capability is based on the implementation of plans, ordinances and programs that demonstrate a local jurisdiction's commitment to guiding and managing growth, development and redevelopment in a responsible manner, while maintaining the general welfare of the community. It

[2] The *Capability Assessment Survey* instrument used to assess county and municipal capabilities is available through the Northern Virginia Regional Commission upon request.

[3] The scoring methodology used to quantify and rank each jurisdiction's capability is fully described in this section of the Plan along with conclusions on local capability.

includes emergency response 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.

This assessment is designed to provide a general overview of the key planning and regulatory tools or programs in place or under development for participating jurisdictions, along with their potential effect on loss reduction. This information will help identify opportunities to address existing gaps, weaknesses or conflicts with other initiatives in addition to integrating the implementation of this Plan with existing planning mechanisms where appropriate.

Table 7.1 provides a summary of the relevant local plans, ordinances and programs already in place or under development for participating jurisdictions. A checkmark (✓) 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.

Table 7.1
Relevant Plans, Ordinances and Programs

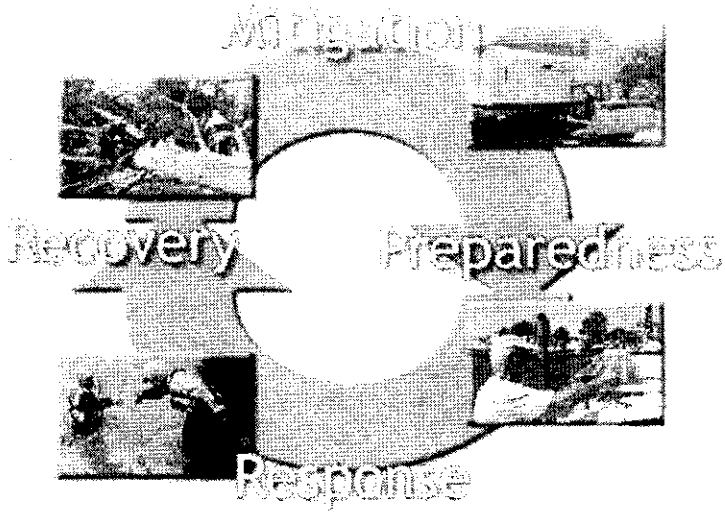
Jurisdiction	Hazard Mitigation Plan	Comprehensive Land Use Plan	Floodplain Management Plan	Open Space Management Plan	Stormwater Management Plan	Flood Response Plan	Emergency Operations Plan	SARA Title III Plan	Radiological Emergency Plan	Continuity of Operations Plan	Evacuation Plan	Disaster Recovery Plan	Capital Improvements Plan	Economic Development Plan	Historic Preservation Plan	Flood Damage Prevention Ordinance	Zoning Ordinance	Subdivision Ordinance	Post-Disaster Redevelopment Ordinance	Building Code	Fire Code	National Flood Insurance Program	NFIP Community Rating System
Arlington County	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓	✓	✓	✓
Fairfax County	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Loudoun County	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Prince William County	✓	✓	✓				✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Alexandria, City of	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓
Fairfax, City of	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Falls Church, City of	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	
Manassas, City of	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Manassas Park, City of	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Dumfries, Town of	✓	✓		✓	✓		✓				✓		✓	✓		✓	✓	✓		✓	✓	✓	
Herndon, Town of	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Leesburg, Town of	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Purcellville, Town of	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Vienna, Town of	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓

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 Northern Virginia Regional Commission.

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 7.1** 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.

Figure 7.1
The Four Phases of Emergency Management



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 the 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.

- Prior to this current mitigation planning process, none of the jurisdictions had completed a hazard mitigation plan.

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.

- Ten (10) out of fourteen (14) jurisdictions have or are developing Disaster Recovery Plans, although some jurisdictions indicate that other plans include this topic, e.g. 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.

- All municipal jurisdictions have or are preparing 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 all jurisdictions with the exception of two (2), have continuity of operations plans in place; the Town of Dumfries and the Town of Purcellville.

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.

- All local jurisdictions have a plan to address radiological emergencies, with the exception of three (3). They are Loudoun County, the Town of Dumfries and the Town of Purcellville.

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

- All the local jurisdictions have an Emergency Response Plan for chemical emergencies, except the Town of Dumfries. They have indicated in their survey response that they depend on Prince William County, the Commonwealth and FEMA in the event of an incident.

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 to 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 all the 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 5-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.[4] 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 harms way.

- Survey results indicate that ten (10) out of fourteen (14) jurisdictions have a historic preservation plan for their communities. Arlington County, the Town of Dumfries and the Town of Vienna indicate that they do not have any plans that address historic preservation.

- In Alexandria, six of the city's most important historic sites are owned and operated by the City of Alexandria and fall under the administration of the Office of Historic Alexandria, the department of City government charged with the conservation, interpretation and promotion of these links to the past.

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 public 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.[5]

- 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.

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

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

- 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 Uniform Statewide Building Code 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).[6] 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 7.2** 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.

Table 7.2
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)

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

Floodplain Management

Flooding represents the greatest natural hazard facing the nation. At the same time the tools available to reduce the impacts associated with flooding are among the most developed when compared to other hazard-specific mitigation techniques. In addition to approaches that cut across hazards, such as education, outreach, and the training of local officials, the *National Flood Insurance Program* (NFIP) contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to flood hazards. Participation in the NFIP is voluntary for local governments, but the program is promoted by FEMA as a first step for implementing and sustaining an effective hazard mitigation program. It is therefore used as a key indicator for measuring local capability as part of this assessment.

In order for a county or municipality to join the NFIP, they must adopt a local flood damage prevention ordinance that requires jurisdictions to follow established minimum building standards in the floodplain. These standards require that all new buildings and substantial improvements to existing buildings will be protected from damage by the 100-year flood, and that new floodplain development will not aggregate existing flood problems or increase damage to other properties. Another key service provided by the NFIP is the mapping of identified flood hazard areas. Once prepared the Flood Insurance Rate Maps (FIRMs) are used to assess flood hazard risk, regulate construction practices and set flood insurance rates. FIRMs are an important source of information to educate residents, government officials and the private sector about the likelihood of flooding in their community.

All jurisdictions in the Northern Virginia region currently participate in the NFIP, and each participating jurisdiction is committed to maintaining continued compliance with the NFIP and where appropriate exceeding the minimum NFIP federal standards. **Table 7.3** summarizes NFIP participation for each of the Northern Virginia region's local jurisdictions along with general NFIP policy data.[7]

Table 7.3
NFIP Participation in the Northern Virginia Region

Jurisdiction	Date of Entry	Current Effective Map	Number of Policies	Amount of Coverage ($)
Arlington County	12/31/1976	5/3/1982	189	34,676,100
Fairfax County	1/7/1972	3/5/1990	2,426	363,189,800
Loudoun County	1/5/1978	7/5/2001	222	50,706,600
Prince William County	12/1/1981	1/5/1995	458	87,103,000
Alexandria, City of	5/8/1970	5/15/1991	1,634	192,650,700
Fairfax, City of	12/17/1971	2/19/2003	226	22,016,900
Falls Church, City of	2/3/1982	7/16/2004	59	11,997,300
Manassas, City of	9/29/1978	7/16/2003	11	1,375,700
Manassas Park, City of	1/3/1979	1/5/1995	60	10,480,900
Dumfries, Town of	5/15/1980	1/5/1995	5	1,017,500
Herndon, Town of	8/1/1979	8/1/1979	20	6,264,600
Leesburg, Town of	9/30/1982	7/5/2001	39	7,219,000
Purcellville, Town of	11/15/1989	7/5/2001	3	870,000
Vienna, Town of	2/3/1982	2/3/1982	46	9,250,500

Source: Federal Emergency Management Agency

[7] General NFIP policy data (participation and coverage) is current as of September of 2004 as provided by the Federal Emergency Management Agency.

An additional indicator of floodplain management capability is the active participation of local jurisdictions in the *Community Rating System* (CRS). The CRS is an incentive-based program that encourages counties and municipalities to undertake defined flood mitigation activities that go beyond the minimum requirements of the NFIP, adding extra local measures to provide protection from flooding. All of the 18 creditable CRS mitigation activities are assigned a range of point values. As points are accumulated and reach identified thresholds, communities can apply for an improved CRS class. Class ratings, which run from 10 to 1, are tied to flood insurance premium reductions as shown in **Table 7.4**. As class ratings improve (decrease), the percent reduction in flood insurance premiums for NFIP policy holders in that community increases.

Table 7.4
CRS Premium Discounts, By Class

CRS Class	Jurisdiction	Premium Reduction
1	-	45%
2	-	40%
3	-	35%
4	-	30%
5	-	25%
6	-	20%
7	-	15%
8	City of Alexandria; Fairfax County; Prince William County	10%
9	Town of Vienna; Arlington County	5%
10	Loudoun County	0

Source: Federal Emergency Management Agency

Community participation in the CRS is voluntary. Any community that is in full compliance with the rules and regulations of the NFIP may apply to FEMA for a CRS classification better than class 10. The CRS application process has been greatly simplified over the past several years based on community feedback to make the CRS more user-friendly. Extensive technical assistance is also available for communities who request it.

- As evident from **Table 7.4**, there are currently six (6) CRS communities in the Northern Virginia region. Of those, three (3) are CRS Class 8 communities, two (2) are CRS Class 9 communities and one (1) is a CRS class 10 community.

Floodplain Management Plan: A floodplain management plan (or a flood mitigation plan) provides a framework for action regarding the corrective and preventative measures in place to reduce flood-related impacts.

- Survey results indicate that eight (8) out of fourteen (14) jurisdictions in Northern Virginia have a floodplain management plan in place. Where the Town of Vienna has indicated NA (not applicable), perhaps implying that it is not needed, the City of Alexandria and the Town of Leesburg have indicated that a floodplain management plan is under development.

Open Space Management Plan: An open space management plan is designed to preserve, protect and restore largely undeveloped lands in their natural state, and to expand or connect areas in the public domain such as parks, greenways and other outdoor recreation areas. In many instances open space management practices are consistent with the goals of reducing hazard losses, such as the preservation of wetlands or other flood-prone areas in their natural state in perpetuity.

- Survey results indicate that all jurisdictions in the region except Prince William County have prepared or are preparing an open space management plan; either separately or as a part of the comprehensive plan.

Stormwater Management Plan: A stormwater management plan is designed to address flooding associated with stormwater runoff. The stormwater management plan is typically focused on design and construction measures that are intended to reduce the impact of more frequently occurring minor urban flooding.

- Survey results indicate that all jurisdictions except Prince William County have prepared, or are preparing a stormwater management plan.

Summary of Planning and Regulatory Capability by Jurisdiction

After an inventory of planning and regulatory capability by topic in the previous section, this section highlights findings from reviewing those documents, i.e. comprehensive plans, zoning ordinances, subdivision ordinances, and open space master plans on file with the Northern Virginia Regional Commission to determine how they relate to potential hazard mitigation goals and policies.

Though many of the plans do not address hazard mitigation directly, often hazards are described in terms of floodplains, steep slopes, and problems soils (including limestone conglomerates). Tree protection policies also were included because of the winter storm risk. Communities should take the opportunity in the next cycle of plan review and update to consider hazard mitigation in their plans. This may include inserting a policy that requires natural hazards to be considered when siting public facilities, or a policy that ensures that infill development does not result in ignoring floodplain restrictions. The extensive development history of the Northern Virginia region could present challenges because of the need to coordinate hazard mitigation and historic preservation goals.

A thorough matrix of the plans and policies reviewed as part of the capability assessment can be found in at the end of this section (*Plan Review Matrix*). The following sections provide a brief overview of highlights for each jurisdiction.

Arlington County

Arlington County has a wealth of plans and polices that could facilitate hazard mitigation. As a participating member of the NFIP, Arlington has a floodplain ordinance that includes a 1 foot freeboard requirement and a 15 foot setback requirement. Arlington County has adopted an Open Space Master Plan that recognizes stream valleys as environmentally sensitive sites in need of protection. In addition, the plan includes a strategy to collaborate with Virginia Power on tree trimming.

Fairfax County

Fairfax County's land classification plan encourages consideration of cluster development, which could be used to create open space and protect stream valleys. The plan recognizes the need to respect the environmental constraints of sites. The revitalization goal should result in steering development to previously developed areas. When redeveloping sites, considerations should include whether they are in hazardous areas.

Fairfax County has a number of goals that address problem soils and development in the floodplain. The plan calls for establishing Environmental Quality Corridors (EQCs) that include the 100-year floodplain, as well as maintaining Resource Protection Areas. The policy plan also includes stormwater management goals.

Fairfax County is a member of the NFIP. Its floodplain ordinance is codified as part of the zoning ordinance and includes an 18 inch freeboard requirement and a 15 foot setback. The ordinance also specifies allowable uses.

Loudon County

Environmental preservation (which includes floodplains and other hazardous areas) can be found throughout Loudoun County's comprehensive plan. The County uses a number of tools to implement its comprehensive plan including proffers, user fees, and special taxing districts. Continued participation in the NFIP is included as a policy in the plan. The plan also describes the need for performance standards for development in limestone conglomerate areas because of the potential sinkhole danger. The open space policies in the plan could also be used to facilitate hazard mitigation.

The NFIP requirements are met in Loudoun County's floodplain overlay district laid out in the zoning ordinance. The ordinance addresses allowable uses and includes a requirement for site plans for all developments in the floodplain. The zoning ordinance also creates two other overlay districts that could be used to meet mitigation goals. They are the Mountainside Development and Creek Valley Overlay Districts.

Prince William County

Prince William County's plan includes policies that address stormwater management, environmental protection, and open space creation. A particularly relevant environmental strategy is to ensure that any construction in a flood hazard district (identified by FEMA) is consistent with the Flood Hazard Overlay District and Chesapeake Bay Preservation Area Overlay District requirements. The plan encourages the use of easements and proffers to protect environmentally sensitive areas.

New development must consider the impact on level of service provided by fire and police stations and take steps to mitigate any impacts. According to the plan, siting of fire and police stations should consider soil conditions.

Prince William has chosen to adopt the NFIP-required regulations as part of its zoning ordinance. The ordinance includes an 18 inch freeboard requirement and a 15 foot setback from the SFHA. Only five low-intensity uses are permitted while all others are prohibited. The ordinance exempts historic buildings from nonconformity requirements.

Alexandria, City of

The comprehensive plan for the City of Alexandria was not available at the Commission. A 1982 Waterfront Design Plan encouraged the continued use of rip-rap and seawalls as edge-defining tools.

As an independent member of the National Flood Insurance Program (NFIP), the City of Alexandria has floodplain regulations. The regulations are part of the City's zoning ordinance and are implemented through an overlay district. The City does not have a freeboard or setback requirement nor do they regulate uses in the floodplain. The Chesapeake Bay Preservation ordinance requires a 100-foot buffer around certain streams, some of which flow through Alexandria.

Fairfax, City of

While the City acknowledges the existence of floodplains and problem soils in its jurisdiction, the comprehensive plan does not address them specifically. Development is directed to preserve existing natural features to the maximum extent possible. The comprehensive plan does include a strategy to eliminate distracting elements from the City's roadways (e.g., overhead wires). While the context of this strategy is community appearance, the undergrounding of utilities can be a successful mitigation measure.

The City's zoning ordinance includes its NFIP-required floodplain regulations. The regulation places strict controls on uses, limiting them to utilities and public facilities, agricultural, outdoor recreational, parking areas, and residential accessory uses. Freeboard requirements of 1 foot and a 15 foot setback from the FEMA delineated Special Flood Hazard Area (SFHA) also are included (the latter is in the County design manual).

Falls Church, City of

The City has a number of policies that could support hazard mitigation efforts. The comprehensive plan requires development proposals to be analyzed with respect to the carrying capacity including impact on natural resources. The plan also recognizes that the City restricts uses and development in all lands within the 100-year floodplain. The plan calls for the zoning ordinance to be revised to reflect principles of "sustainable development" as set forth in the document.

Since the City is essentially built out, the plan recognizes that future development will be the redevelopment of existing properties. The plan requires that redevelopment plans address previously ignored environmental issues and include a map of physical constraints that shows floodplains and soils.

Creation and maintenance of open space is a large portion of the plan. One of the strategies included in the plan is the creation of a greenway/natural park along Four Mile Run. Implementation tools mentioned include acquisition through fee simple, easement, or eminent domain, which shows a willingness of the City to use these tools when needed. Citizen education and involvement is also highlighted in the plan indicating that the City is able to do extensive public outreach and perhaps involve the public in mitigation projects.

Manassas, City of

The comprehensive plan for the City of Manassas mentions 100-year floodplains but does not address them any further. One of the land use planning concepts, however, is that "residential areas should be reasonably free from potential hazards." The subdivision ordinance also requires that land subject to "flooding and deemed topographically unsuitable shall not be platted for residential occupancy."

The floodplain management ordinance is separate from the zoning ordinance. The zoning ordinance does require that the final site plan include information regarding the location of fire hydrants and storm drainage system (including floodplains).

Manassas Park, City of

The comprehensive plan of the City of Manassas Park does not address hazard mitigation nor does it include any environmental goals that could be related to mitigation. The closest relationship is the land use goal, which says that development should be cost-effective.

The City's subdivision ordinance requires that "land subject to flooding and land deemed topographically unsuitable shall not be platted for residential occupancy, or for such other uses in such a way as to endanger health, life, or property, or aggravate erosion of flood hazards."

In addition, the City has a floodplain overlay district as part of its zoning ordinance. The district is defined as four sub-districts (floodway, floodway-fringe, approximated floodplain, and shallow floodplain). Mobile homes are prohibited in the floodway. Allowable uses for the floodway are delineated while development in the other three sub-districts is allowed as long as it is floodproofed. The ordinance also includes procedures for nonconforming structures.

Dumfries, Town of

The comprehensive plan for Dumfries addresses hazard mitigation indirectly through the policies conserving stream valleys and other sensitive areas. In addition, the plan calls for limiting development in areas with problem soils.

The Town uses a floodplain overlay district to enforce its floodplain management policies. The district is implemented as part of the Town's zoning ordinance. The ordinance requires that the zoning administrator determine that the building site is reasonably safe from flooding before development is permitted. Uses in the floodway are limited to agricultural, public and private recreational, and those that are accessory to residential, industrial and commercial uses. The uses permitted in the flood-fringe and approximated floodplain are much broader; all uses that are allowed in underlying districts are allowed as long as elevation or floodproofing can be shown.

Herndon, Town of

Herndon's comprehensive plan shows concern for the natural environment and recognition of the need to develop within its restraints. The plan prohibits new development in the floodplain. The plan also calls for the floodplain ordinance to be updated. Tree maintenance is another component of the plan. A program component includes the continual budgeting for tree planting, tree removal, and tree maintenance and care.

In recognition of the advanced state of development in the town, the plan includes guidance on redevelopment and infill development. Evaluation guidelines for such projects, which could contribute towards risk reduction, include:

- placement of utility lines underground,
- efforts to minimize impervious surfaces,
- provision of stormwater detention/retention,
- grass swales as surface drainage, and
- restoration of the floodplain.

In addition, the plan indicates that redevelopment efforts should avoid the floodplain.

The Town's zoning ordinance contains its floodplain management requirements. As with other jurisdictions in the region only a limited number of uses are permitted in the floodplain. These uses are agricultural uses, public and private recreational uses and activities, and utility and public facility improvements.

Leesburg, Town of

Leesburg's 1997 comprehensive plan's goals include assuring that development respects environmental factors. These factors include floodplains and geology. Sinkholes and shrink-swell soils are identified as potential hazards by the Town of Leesburg in its comprehensive plan. Concern for these hazards is reflected in the objectives limiting development on steep slopes and controlling development on problem soils. With respect to flooding issues, the Town policies include preserving the 100-year floodplain within the Town's limits and keeping waterways clear of litter and debris.

Floodplain management practices are contained within the Town's zoning ordinance, as a separate floodplain overlay district. By-right uses are limited to agricultural, public and private recreational uses, and accessory residential, commercial and industrial uses. Conditional uses include utilities, and temporary uses such as circuses and storage. Mobile homes are prohibited in the floodplain, unless in an existing mobile home park. The ordinance also provides guidance for considering variance requests on nonconforming structures.

Purcellville, Town of

The Town of Purcellville's comprehensive plan states that a harmonious pattern of land use should be encouraged. The first land use objective addresses delineating land districts for conservation and other uses to separate incompatible uses. The land use element also recognizes the need to protect the South Fork of the Catoctin Creek and its floodplain, in part through enforcing the floodplain management ordinance. The plan demonstrates the willingness of the Town to use various tools to control development including zoning, subdivision regulations and capital improvements programming.

Vienna, Town of

Vienna's Town Plan addresses stream valley protection and stormwater management but does not specifically address floodplain management. The plan also supports the replacement of utility lines in the commercial area with underground lines, particularly along Maple Avenue. While the rationale for this has an aesthetic basis, it could have a mitigation effect as well.

The Town includes floodplain management as part of its zoning ordinance, which includes floodplains as an overlay district. The ordinance requires that any development in the floodplain must obtain a permit before it begins. The ordinance also provides guidance on issuing variances and on nonconforming structures. In addition, the zoning ordinance includes a flood hazard mitigation provision. Among other provisions, the section requires that electric water heaters, electric furnaces and other critical electrical installations in the floodplain be elevated. Other vital appliances (i.e., HVAC) need to be designed to prevent water infiltration.

Administrative and Technical Capability

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. 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 Geographic Information Systems (GIS) to analyze and assess community hazard vulnerability.

The *Capability Assessment Survey* was used to capture information on administrative and technical capability through the identification of available staff and personnel resources. **Table 7.5** provides a summary of the results for participating jurisdictions. A checkmark (✓) indicates that the given local staff member(s) is maintained through each particular jurisdiction's local government resources. Additional information on administrative and technical capability for the Northern Virginia region is provided in the hard copies of the completed surveys, which can be obtained through the Northern Virginia Regional Commission.

Table 7.5
Relevant Staff / Personnel Resources

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	Resource development staff or grant writers
Arlington County	✓	✓		✓		✓	✓	✓	✓	
Fairfax County	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Loudoun County	✓	✓	✓	✓				✓	✓	
Prince William County	✓	✓	✓	✓	✓	✓		✓	✓	✓
Alexandria, City of	✓	✓	✓	✓	✓	✓		✓	✓	✓
Fairfax, City of	✓	✓	✓		✓			✓	✓	
Falls Church, City of	✓	✓	✓	✓	✓			✓	✓	✓
Manassas, City of	✓	✓	✓		✓	✓		✓	✓	
Manassas Park, City of	✓	✓	✓	✓	✓	✓		✓	✓	✓
Dumfries, Town of	✓	✓	✓	✓						✓
Herndon, Town of	✓	✓	✓	✓	✓				✓	✓
Leesburg, Town of	✓	✓							✓	
Purcellville, Town of	✓	✓	✓	✓	✓	✓		✓	✓	✓
Vienna, Town of	✓	✓	✓	✓	✓				✓	

Fiscal Capability

The ability of a local government to take action is often closely associated with the amount of money available to implement policies and projects.[8] This may take the form of outside grant funding awards or locally-based revenue and financing. The costs associated with mitigation policy and project implementation vary widely. In some cases, policies are tied primarily to staff time or administrative costs associated with the creation and monitoring of a given program. In other cases, direct expenses are linked to an actual project such as the acquisition of flood-prone homes, which can require a substantial commitment from local, state and federal funding sources.

The *Capability Assessment Survey* was used to capture information on each jurisdiction's fiscal capability through the identification of locally available financial resources. **Table 7.6** provides a summary of the results for participating jurisdictions. A checkmark (✓) indicates that the given fiscal resource is locally

[8] Gaining access to federal, state or other sources of funding is often an overriding factor driving the development of hazard mitigation plans. However, an important objective of local governments seeking a more sustainable future is the concept of self reliance. Over time, local jurisdictions should seek the means to become less dependent on federal assistance, developing a more diversified approach that assesses the availability of federal, state and locally-generated funding to implement mitigation actions. Additional assistance may be available from the business and corporate sector as well as certain non-profit organizations. This should be coupled with an attempt to identify mitigation measures that cost little or no money, yet may complement the larger array of actions identified in the plan.

available for hazard mitigation purposes (including match funds for state and federal mitigation grant funds). Additional information on fiscal capability for the Northern Virginia region is provided in the hard copies of the completed surveys, which can be obtained through the Northern Virginia Regional Commission.

Table 7.6
Relevant Fiscal Resources

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
Arlington County	✓	✓						✓	✓
Fairfax County	✓	✓	✓	✓	✓			✓	✓
Loudoun County	✓	✓	✓					✓	
Prince William County	✓	✓	✓		✓	✓	✓	✓	✓
Alexandria, City of	✓	✓	✓		✓		✓	✓	✓
Fairfax, City of	✓		✓		✓				
Falls Church, City of	✓	✓			✓	✓	✓	✓	✓
Manassas, City of	✓	✓	✓	✓	✓	✓		✓	✓
Manassas Park, City of	✓	✓			✓	✓		✓	✓
Dumfries, Town of	✓	✓	✓	✓	✓	✓	✓	✓	✓
Herndon, Town of	✓	✓	✓		✓			✓	✓
Leesburg, Town of	✓			✓	✓			✓	✓
Purcellville, Town of	✓	✓			✓			✓	✓
Vienna, Town of	✓								

Political Capability

One of the most difficult capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects designed to reduce the impact of future hazard events. Hazard mitigation may not be a local priority, or may conflict with or be seen as an impediment to other goals of the community, such as growth and economic development. Therefore the local political climate must be considered in designing mitigation strategies, as it could be the most difficult hurdle to overcome in accomplishing their adoption and implementation.

The *Capability Assessment Survey* was used to capture information on each jurisdiction's political capability. Survey respondents were asked to identify some general examples of political capability for their jurisdiction, such as guiding development away from identified hazard areas, restricting public investments or capital improvements within hazard areas, or enforcing local development standards that go beyond minimum state or federal requirements (e.g. building codes, floodplain management, etc.). **Table 7.7** provides a summary of the individual responses for each jurisdiction in the Northern Virginia region.

Table 7.7
Political Capability

Jurisdiction	Comments
Arlington County	Political environment is highly supportive of mitigation planning. Implementation of cost-neutral projects have a high chance of being accomplished. Mitigation strategies for anti-terrorism based upon limiting public access to government facilities will be very limited.
Fairfax County	The Environmental Quality Corridor policy recommends that areas including 100-year floodplains, adjacent steep slopes (15% or greater), wetlands connected to stream valleys, and minimum buffer areas adjacent to streams be protected from development. Negotiations for EQC protection are sought during the zoning process. EQCs are often broader in extent than floodplains and Resource Protection Areas, which are afforded substantial protection through the County Code. In addition, the County's Resource Protection Area designation includes Major Floodplains (floodplains associated with streams that collect drainage from an area equal to or greater than 360 acres). This goes beyond minimum state requirements for RPA designations. In addition, the County has provided for specific Chesapeake Bay Preservation area regulations. Additionally as noted in the survey results, the County has adopted a Zoning Ordinance, Subdivision Ordinance, Public Facilities Manual, and Building and Fire Code requirements. These regulations all serve to protect upon encroachment on environmentally sensitive areas such as wetlands, floodplains and areas of unsuitable soils.
Loudoun County	No comments provided
Prince William County	The local political leadership generally does not fight with citizens when it comes to building in hazardous areas such as flood zones or allowing rebuilding in flood zones
Alexandria, City of	Alexandria ranks 11th in the United States in terms of density of population (8,000 people per square mile) which makes it difficult to reduce geographical based hazards
Fairfax, City of	The City of Fairfax has implemented a strong approach to restricting construction in areas subject to flooding. Regulations governing operations and expansion of the bulk petroleum storage facility located within the City have also been implemented and are strictly enforced.
Dumfries, Town of	Our Public Works Department is working on adopting the Prince William County Designs and Construction Standard Manual (DCSM). We are also updating our comprehensive plan. Also, updating and adopting our capital improvement plan is critical for our hazard mitigation plan.
Falls Church, City of	(1) active floodplain management / restriction on construction in the floodplain, (2) limits on impervious surfaces; (3) planning and zoning review regarding building density and lot coverages; (4) active arborist review of all building and site plans.
Manassas, City of	City Council Directed Strategic Goals * Multi-year Strategic Plans * Personnel Staffing Plans * Comprehensive Plans * Flood Plain Management Plans * Community Development Plans * GIS Mapping * Comprehensive Zoning Codes * Building Codes
Manassas Park, City of	The Governing Body is ready and able to take such action as may be required to protect vital national and local interests, including those actions which may cause objection by local residents, if necessary.
Herndon, Town of	1. Under Town Council direction, the Police Department has recently prepared an Emergency Management Plan for the Town of Herndon. Assistance from Fairfax County Department of Emergency Management was instrumental in the preparation of this plan. 2. On February 10, 2004, the Town amended its Chesapeake Bay Preservation Area Overlay District Ordinance in accord with mandated state regulations. These amendments eliminated the Resource Management Area water quality opt out provision, which exempted developers from providing water quality measures if the land did not contain wetlands, steep slopes, highly erodible soils and floodplain.
Leesburg, Town of	No comments provided
Purcellville, Town of	The Town applies all of the above noted standards and employs mitigation measures where appropriate to prevent future impacts that could result in hazards e.g. flooding. The Town is presently considering the application of a Tree Ordinance to protect vulnerable areas from erosion, etc.
Vienna, Town of	Chesapeake Bay Preservation Areas Ordinance- Chapter 18, Article 21.1 of Town of Vienna Code; Floodplain Ordinance Chapter 18.1 of the Town of Vienna Code

Local Self Assessment

In addition to the inventory and analysis of specific local capabilities, the *Capability Assessment Survey* required each local jurisdiction to conduct its own self assessment of its capability to implement hazard mitigation activities. As part of this process, county and municipal officials were encouraged to consider the barriers to implementing proposed mitigation strategies in addition to the mechanisms that could enhance or further such strategies. In response to the survey questionnaire, local officials classified each of the aforementioned capabilities as either "limited," "moderate" or "high."

Table 7.8 summarizes the results of the self assessment process for participating jurisdictions. An "**L**" indicates limited capability; an "**M**" indicated moderate capability; and an "**H**" indicates high capability.

Table 7.8
Self Assessment of Local Capability

Jurisdiction	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Political Capability	Overall Capability
Arlington County	M	M	M	M	M
Fairfax County	H	H	H	H	H
Loudoun County	M	M	L	M	M
Prince William County	H	H	M	M	M
Alexandria, City of	M	M	M	M	M
Fairfax, City of	H	M	H	H	H
Falls Church, City of	M	L	L	M	M
Manassas, City of	H	M	M	H	M
Manassas Park, City of	M	M	M	H	M
Dumfries, Town of	M	H	H	L	M
Herndon, Town of	H	M	L	M	M
Leesburg, Town of	H	H	M	L	M
Purcellville, Town of	M	H	M	H	M
Vienna, Town of	L	L	L	L	L

Conclusions on Local Capability

In order to form meaningful conclusions on the assessment of local capability, a quantitative scoring methodology was designed and applied to results of the *Capability Assessment Survey*. This methodology, further described below, attempts to assess the level of capability for participating jurisdictions, by determining a general capability rating for each.

Points System for Capability Ranking

Scoring:

0-24 points = Limited overall capability
25-49 points = Moderate overall capability
50-80 points = High overall capability

I. Planning and Regulatory Capability (Up to 45 points)

Yes=3 points Under Development or Under County Jurisdiction=1 point No=0 points

- Hazard Mitigation Plan
- Comprehensive Land Use Plan
- Floodplain Management Plan
- Participate in CRS Program
- BCEGS Grade of 1 to 5

Yes=2 points Under Development or County Jurisdiction=1 point No=0 points

- Open Space Management / Parks & Rec. Plan
- Stormwater Management Plan
- Emergency Operations Plan
- Flood Response Plan
- SARA Title III
- Radiological Emergency Plan
- Continuity of Operations Plan
- Evacuation Plan
- Disaster Recovery Plan
- Flood Damage Prevention Ordinance
- BCEGS Grade of 6 to 9

Yes=1 point No=0 points

- Capital Improvements Plan
- Economic Development Plan
- Historic Preservation Plan
- Zoning Ordinance
- Subdivision Ordinance
- Unified Development Ordinance
- Post-disaster Redevelopment / Reconstruction Ordinance
- Building Code
- Fire Code
- Participate in NFIP Program

II. Administrative and Technical Capability (Up to 15 points)

Yes=2 points No=0 points

- 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

Yes=1 point No=0 points

- 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
- Resource development staff or grant writers

III. Fiscal Capability (Up to 10 points)

Yes=1 point No=0 points

- 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/ Revenue/ Special Tax Bonds
- Partnering arrangements or intergovernmental agreements
- Other

IV. Self-Assessment of Overall Capability (Up to 10 points)

High=2 points Moderate=1 point Low=0 points (Self-ranked by jurisdiction)

- Technical Capability
- Fiscal Capability
- Administrative Capability
- Political Capability
- Overall Capability

Note: This methodology is based on best available information. If a jurisdiction does not provide information on any of the above items, a point value of zero (0) was assigned for that item.

Table 7.9 shows the results of the capability assessment using the designed scoring methodology. According to the assessment, the average local capability score for participating jurisdictions is **57.71** which indicates an **overall high capability** for the Northern Virginia region.

Table 7.9
Capability Assessment Results

Jurisdiction	Capability Score	Capability Rating
Arlington County	50	High
Fairfax County	75	High
Loudoun County	57	High
Prince William County	62	High
Alexandria, City of	62	High
Fairfax, City of	61	High
Falls Church, City of	59	High
Manassas, City of	65	High
Manassas Park, City of	67	High
Dumfries, Town of	49	Moderate
Herndon, Town of	64	High
Leesburg, Town of	50	High
Purcellville, Town of	58	High
Vienna, Town of	39	Moderate

The capability of participating jurisdictions to implement mitigation actions is moderate to high. Ten (10) out of the fourteen (14) jurisdictions rank "High", reflecting the high capabilities of municipalities in the Northern Virginia region. It is worth noting, however, that the scoring methodology used to conduct this capability assessment is only meant to provide a general understanding of local capability for each jurisdiction relative to one another. The results are based solely on the information provided by local officials in response to the *Capability Assessment Survey*, an instrument designed to measure local capability based on those indicators determined to be most relevant for mitigation purposes and referenced in FEMA planning guidance.

According to the assessment, local capability only slightly varies between the local jurisdictions. The Town of Dumfries, the Town of Vienna, the Town of Leesburg, and Loudoun County, that are ranked "Moderate" also have a variety of planning mechanisms in place that have the potential to be utilized as vehicles for mitigating losses from hazards.

Perhaps one of the most significant findings of the assessment is the widespread existence of several planning initiatives, programs and tools already in place across the Northern Virginia region. This is not a surprise considering it is one of the most important growth areas around the Washington D.C. metropolitan area. As a result, jurisdictions know the importance of planning for physical development, and its effects on the region's economic health and well being of the community.

All participating jurisdictions possess a vision and the tools for addressing issues and developing strategies related to future land use planning, provision of infrastructure such as sewer, water, and public services such as police and fire protection. The next step for this region's local governments is to apply this coordination to hazard mitigation.

This Hazard Mitigation Plan is the beginning of that coordination. However, in order to succeed it will require clearly articulating the benefits of participating in and sustaining the region-wide mitigation planning process. One of the best ways to obtain local buy-in and long-term success is to identify and implement achievable mitigation actions (as listed in each jurisdictions' individual Mitigation Action Plans)

that will facilitate continued intergovernmental coordination across the region and with state and federal agencies as well.

Linking the Capability Assessment with the Risk Assessment and the Mitigation Strategy

The conclusions of the *Risk Assessment* and *Capability Assessment* serve as the foundation for a meaningful hazard mitigation strategy. During the process of identifying specific mitigation actions to pursue, each jurisdiction must consider not only their level of hazard risk but also their existing capability to minimize or eliminate that risk. **Figure 7.2** shows a *Risk vs. Capability Matrix* that is used to illustrate each jurisdiction's overall hazard risk[9] in comparison to their overall capability. This matrix has been completed (marked with a "✓") for each of the jurisdictions in the Northern Virginia region and is included in each jurisdiction's separate and distinct *Mitigation Action Plan* provided in Section 9 of this Plan.

Figure 7.2
Risk vs. Capability Matrix

		HAZARD RISK		
		Limited	Moderate	High
OVERALL CAPABILITY	High			
	Moderate			
	Limited			

In jurisdictions where the overall hazard risk is considered to be HIGH, and local capability is considered LIMITED, then specific mitigation actions that account for these conditions should be considered. This may include less costly actions such as minor ordinance revisions or public awareness activities. Further, specific capabilities may need to be improved in order to better address recurring threats. In cases where the hazard vulnerability is LIMITED and overall capability is HIGH, more emphasis can be placed on actions that may impact future vulnerability such as guiding development away from known hazard areas.

[9] Overall hazard risk was determined for each jurisdiction using the results of the risk assessment (estimated losses for all natural hazards) combined with specific information on the following factors: total population, population growth rate, land area, historical disaster declarations, unique hazard risks, NFIP participation and the value of existing Pre-FIRM structures. More information on the methodology used to determine overall hazard risk is available through the Northern Virginia Regional Commission upon request.

Plan Review Matrix

Comprehensive plans, zoning ordinances and other planning documents (e.g., subdivision ordinances, open space master plans) on file with the Northern Virginia Regional Commission were reviewed to determine how they relate to potential hazard mitigation goals and policies. The following plan review matrix includes short descriptions and excerpts from the local policies and plans made available for review. According to the review, these plans and policies were described as having a *positive, neutral, or negative* effect on hazard mitigation. In general, neutral was used where hazards were not specifically mentioned but the element could be interpreted or modified to include hazard mitigation.

Jurisdiction	Plan Name	Date Adopted	Excerpts/Details of Document	Effect?
Arlington County	Comprehensive Plan	August 12, 1961 with amendments through June 30, 1996	*Purpose:* Guide the coordinated and harmonious development of Arlington County through the provision of high standards of public services and facilities based on...provision of an adequate storm water drainage system.	Neutral
Arlington County	Floodplain Ordinance of Arlington County, Virginia	Sept. 24, 1977	*County Code, Chapter 48 Floodplain Management* *Summary:* - Meets NFIP requirements. - Includes all areas subject to inundation by the waters of the one hundred-year flood. - Two districts – mapped floodplain and approximated floodplain. - No mobile homes or manufactured homes shall be permitted in the floodplain. - Any development or use of land shall be undertaken in strict compliance with the floodproofing and related provisions - Encroachment into the floodway should not result in result in any increase in the one hundred-year flood elevation. - All new construction of and substantial improvements to residential structures shall be set back fifteen (15) feet horizontally from the location of the base flood elevation. - All new construction of and substantial improvements to nonresidential structures shall be set back fifteen (15) feet horizontally from the location of the base flood elevation, unless such structures are floodproofed. *Article IV. Flood Damage Control Regulations* - All new or replacement public and private utilities located in the floodplain district shall be elevated or floodproofed to a point at one (1) foot or more above the base flood elevation. - Similar requirements for utilities. - All buildings and structures shall be constructed and placed on the lot so as to offer the minimum obstruction to the flow of water and shall be designed to have a minimum effect upon the flow and height of flood waters.	Positive
Arlington County	General Land Use Plan	August 12, 1961 (amendments through	Goals cited on website relate to density and residential and commercial development.	Neutral

Jurisdiction	Plan Name	Date Adopted	Description/Details of Document	Impact
		June 30, 1996)		
Arlington County	Open Space Master Plan	June 1994 (final draft) Final adopted September 1994	*Goal:* Arlington County shall ensure, for this and future generations, the provision of an adequate supply of beneficial open space which is safe...and shall take the necessary steps to protect, enhance and acquire open space to meet these needs. *Objective 1, Strategy A, Action agenda:* Acquire unique open space sites as they become available to protect shorelines and wetlands, non-wetlands which act as pollutant filters, wildlife areas, other natural assets and vistas endangered by urbanization and cultural and historic resources. *Objective1, Strategy C:* Use the full range of appropriate fiscal and zoning mechanisms to acquire, protect and preserve open space. *Objective1, Strategy C, Action agenda*: Establish a new natural Area Zoning District for environmentally significance or sensitive areas, such as stream valleys and woodlands which should be preserved in a natural undeveloped state. Rezone accordingly. *Objective 3:* Arlington County should preserve appropriate areas to conserve ecological resources, protect environmentally significant areas and protect cultural and historic resources. *Objective 6, Strategy A:* Adopt and implement a County-wide tree ordinance to protect desirable trees and vegetation and enhance the tree canopy. *Action agenda.* Collaborate with Virginia Power to develop a standard County-wide tree trimming policy.	Positive
Arlington County	Storm Water Master Plan	September 1996	Addresses new state and federal environmental laws and regulations, floodplain management issues, concerns regarding stream valley conditions, and new technology, design methods, and engineering practices.	Positive
Arlington County	Subdivision Ordinance		*Chapter 23 Subdivisions Section 23-2:* The purpose of this chapter is to provide for: (I) The provision of proper erosion and sedimentation control, drainage, stormwater management and flood control.	Positive
Arlington County	Zoning Ordinance		*Section 3. "S-3A" Special Districts:* - The purpose of the "S-3A" Special District is to encourage the retention of certain properties in a relatively undeveloped state. Land so designated may include publicly or privately owned properties which have distinct and unique site advantages or other features so as to make them desirable to retain as active or passive recreation or for a scenic vista. Stream valleys could be included in this district. - Permitted uses: ▪ Public parks, playgrounds, recreational and community center buildings and grounds. ▪ Semipublic or private parks and recreation areas ▪ Public buildings and properties of a cultural, recreational administrative or service type. ▪ Country clubs, golf courses, and other private noncommercial recreational areas and facilities	Neutral

Jurisdiction	Plan Name	Date Adopted	Scope/Details of Document	Effect?
			or recreation centers, including swimming pools. ▪ Cemeteries, but not including crematoriums. ▪ Churches and other places of worship and Sunday school buildings, but excluding rescue missions or temporary revivals. ▪ Public and private arboretums, forests, wild life reservations and conservation areas, including stream valley drainage areas. ▪ Single-family dwelling on lot with a minimum area of three (3) acres per dwelling unit. ▪ Secondary uses of churches, schools, public buildings and public properties - Conditional uses: ▪ Hospitals and institutions of an educational, religious, charitable, or philanthropic ▪ Public utilities and services ▪ Schools and colleges and other public and private educational institutions ▪ Institutional homes, counseling service, occupational therapy, and similar social service uses. ▪ Accessory buildings ▪ Public parking area ▪ commercial use of an existing structure on a transitional site in conjunction with and primarily for the purpose of providing services to an existing adjacent use ▪ Off-site parking area incidental to a use permitted in an "S," "R" or "RA" District ▪ Publicly owned public parking area ▪ Recycling centers	
Fairfax County	Concept for Future Development and Land Classification System	August 6, 1990	*Suburban Neighborhoods* - *Environmental Guidelines*: On sites with sensitive environmental features which make standard development practices impractical, innovative design techniques such as clustering of residential uses should be explored as a means of preserving the environment. *Low Density Residential Areas* - *Land Use Guidelines*: The establishment of open space uses, such as Stream Valley Parks and Forestal Districts, should be encouraged in these areas. - *Environmental Guidelines*: Development in these areas should be designed with utmost sensitivity to the natural environment. Suburban centers - *Land Use Guidelines*: Development in non-core areas should reflect a campus-like setting with large areas of open space. - *Environmental Guidelines*: In non-core areas, the integration of existing site characteristics such as streams, vegetation and topography into site development should be encouraged in order to	Neutral

Jurisdiction	Plan Name	Date Adopted	Excerpts/Details of Document	Effects
			conserve natural features and to enhance the man-made environment. - In general – preserve EQC where possible.	
Fairfax County	Policy Plan: The Countywide Policy Element of the Comprehensive Plan for Fairfax County, Virginia	August 6, 1990	*Preface* - *Land Use*: the County's land use policies should…provide for orderly and coordinated development for both public and private uses while sustaining the economic and social well-being of the County;…and ensure sound environmental practices in the development and redevelopment of land resources. - *Environmental Protection*: The amount and distribution of population density and land uses in Fairfax County should be consistent with the environmental constraints inherent in the need to preserve natural resources…Development in Fairfax County should be sensitive to the natural setting, in order to prevent degradation of the County's natural environment. - *Open Space:* Fairfax County should support the conservation of appropriate land areas in a natural state to preserve, protect, and enhance stream valleys…wetlands… - *Revitalization*: Fairfax County should encourage and facilitate the revitalization of older areas of the County where present conditions warrant. *Land Use* - *Land use policies*: in general, focus on creating more efficient development pattern - *Objective 12 – Policy g* – Locate and limit development intensity in a manner which will not adversely impact sensitive environmental areas. - *Objective 14 – Policy j* – Use cluster development as one means to enhance environmental preservation when the smaller lot sizes permitted would compliment surrounding development. *Objective 14 - Policy k* – Provide incentive for the preservation of EQCs by allowing a transfer of some density potential on the EQC area to less sensitive portions of the site. *Environment* - *Objective 3* – Protect the Potomac Estuary and the Chesapeake Bay from the avoidable impacts of land use activities in Fairfax County. *Objective 7* – Ensure that new development either avoids problem soil area, or implements appropriate engineering measures to protect existing and new structures from unstable soils. *Policy a* – Limit densities on slippage soils, and cluster development away from slopes and potential problem area. *Policy b* – Require new development on problem soils to provide	Land Use – Neutral Environment - positive Public Facilities – positive Parks and Recreation - neutral

Jurisdiction	Plan Name	Date Adopted	Excerpts/Details of Document	Effect?
			appropriate engineering measures to ensure against geotechnical hazards. - *Objective 8* – Minimize the exposure of new development to the potential of flood impacts; policy a – Prohibit new residential structures within flood impact areas. - *Objective 9, policy a* – For ecological resource conservation, identify, protect, and restore an Environmental Quality Corridor (EQC). EQC will include 100-year flood plains as defined by Zoning Ordinance, all areas of 15% or greater slopes adjacent to flood plain (or if no floodplain present, within 50 feet of stream). *Policy b* – To provide an incentive for the preservation of ECQs while protecting the integrity of the system, allow a transfer of some of the from the ECQ portion of developing sites to the less sensitive portions of these sites. - *Objective 11* – Conserve and restore tree cover on developed and developing sites. Prove tree cover on sites where it is absent prior to development. *Public Facilities* - *Objective 37* – Provide a system of drainage facilities that prevents or minimizes structure flooding, stream degradation and traffic disruption in an efficient, cost effective and environmentally sound manner. *Policy b* – continue to regulate development on filling land within the 100-year floodplain. *Policy d* – require a regional approach to stormwater management in developing and in redeveloping sites. *Parks and Recreation* - *Objective 2* – Preserve appropriate land areas in a natural state to conserve ecological resources, protect environmentally and historically significant area, and maintain open space in developed areas. - *Objective 5 – policy b* – Enhance existing recreation and resource protection opportunities through acquisition of adjacent lands, including those segments of EQCs needed to complete the public stream valley trail system. - *Appendix 9* – Adopted Sept. 9, 2002 – Rezoning for residential development should include protecting, enhancing or restoring the habitat value and pollution reduction potential of floodplains,...ECQs,...and other environmentally sensitive areas. Should take existing topographic conditions and soil characteristics into consideration.	
Fairfax County	Zoning Ordinance	June 12, 1978	*General Regulations* *Part 4 2-415: Yard Regulations for Lots Having Area in Floodplain* - No dwelling shall be located closer than 15 feet from edge of floodplain. *Part 6 2-600: Land Regulations*	Positive

Jurisdiction	Plan Name	Date Adopted	Excerpts/Details of Document	Effect?
			- *Section 2-602: Drainage, Floodplains, and Wetlands* - Addresses filling, change of contour or establishment of uses in floodplains, wetlands or Resource Protection Areas (generally prohibited with exceptions). *Part 9 2-900: Floodplain Regulations* - Permitted uses (as long as permitted in underlying zone) – any use within minor floodplain (70 acres < drainage area < 360 acres); agricultural; residential accessory; community, commercial, and public recreational uses; off-street parking and loading areas; Metrorail, railroad track and roadway floodplain crossings meeting certain standards; public and private utility lines; additions to single family dwellings that meet certain criteria; and topographic improvements that do not require major fill. - Special exception uses – all uses permitted by right, special permit or special exception in underlying zone but not listed above – application must include additional set of information delineated in ordinance. - All uses shall not increase water surface elevation above the 100-year flood level upstream or downstream; except otherwise permitted, lowest elevation of lowest floor should be 18 inches above water-surface elevation of 100-year flood. *Article 15 – Nonconforming Uses* – addresses buildings that suffer damage that is 50% or more of current appraised value.	
Loudoun County	Zoning Ordinance	Oct. 22, 1991 (last amended January 2003)	*4-1900 Floodplain Overlay District* - Qualifies residents for NFIP. - Identifies sources for delineating floodplain (FEMA, USDA, USGS, ACOE, etc.) - Boundaries shown on Floodplain Map of Loudoun County – regulations apply at a minimum to all areas within boundary. - Permitted uses: for areas greater than 640 acres – agricultural; fishery; public or private recreational; stormwater management improvements associated with by-right or permitted uses; utility lines, road crossings, privates dives serving up to 7 (seven) lots and private access easements serving low density development; repair/reconstruction/improvement of existing residence not constituting substantial improvements (>50% of market value); parking areas; incidental structures not exceeding 840 sq ft; temporary storage; alterations of floodplain meeting certain standards; restoration and rehabilitation of listed or eligible historic structures; road crossing (subject to certain criteria). For areas less than 640 acres – all uses above; alterations of floodplain; stormwater management improvements; farm ponds; basketball or tennis courts and swimming pools; parking areas less than 5000 sq ft. - Special exception uses: marinas, boat rentals,	Positive

Jurisdiction	Plan Name	Date Adopted	Excerpts/Details of Document	Effect?
			docks, piers, wharves, water ski jump facilities and related incidental uses; carnivals, circuses and similar transient amusement enterprises; riding stables; structures or uses required for operation of public utility, road crossings and stormwater management otherwise nor permitted by right; roads and ponds in Potomac watershed; incidental structures greater than 840 sq ft – sets standards for determining special exceptions. - Lays out procedures for altering floodplain. - Requires site plans and building permits for all uses in floodplain district – must conform to building code including floodproofing requirements. - Explains how to factor in floodplain when determining density calculations. *Section 4-2000 Mountainside Development* - Ensure development is compatible with slope of the land, soil and topography, and prevent erosion. Implement Comprehensive Plan. Overly district defined by presence of certain natural features including elevation, steep slopes and unstable soils (among others). Imposes performance standards for two of three areas, otherwise underlying zoning applies. Third area – by-right (but meeting certain criteria) is agricultural and timber harvesting; detached, single family. Special exception – underlying zoning but must meet criteria for development. *Section 4-2100 – Creek Valley Overlay District* - Supplements floodplain ordinance, implements comprehensive plan. Overlay (including over floodplain districts) district. Has limited number of by right and special exception uses.	
Loudoun County	Loudoun County General Plan	Sept. 17, 2001 (last amended June 7, 2005)	*Preface* - *Goals* – Ensure Loudon is environmentally sound – protecting, sustaining, and enhancing the County's air quality, water resources, soils, ... and other natural and man-made resources... - Seek the development of neighborhoods within Loudoun's communities designed or revitalized in conformance with the natural environment... - Ensure rural residential development that maintains rural character, preserves the environment...and natural features, and develops at overall densities that do not exceed the capacity of rural road and public facilities, or compromise the growth of the rural economy. - Recognize the private property rights of the individual within a balanced framework that considers the public interest and shared values of the community. Chapter 2 – *General Plan Strategy, Policy 1* - The key strategy of the Plan is the integration of Loudoun's natural, environmental, cultural and	Fiscal Planning and Public Facilities – neutral The Green Infrastructure – positive Rural Policy Area - positive Transition Policy Area - neutral Implementation - positive

Jurisdiction	Plan Name	Date Adopted	Excerpt/Details of Document	Edits?
			heritage resources into a unified Green Infrastructure (GI) strategy. The GI will shape land uses throughout the County in all policy areas. It will be a structuring element of development, with its features becoming a part of every new project. The County is committed to the preservation and enhancement of its GI assets for their economic value and contribution to the quality of life of present and future residents. Chapter 3 – *Fiscal Planning and Public Facilities* – - *Fiscal Planning Budgeting Policies: 4.* The County will seek the provision of necessary public facilities, utilities, and infrastructure concurrent with development through a variety of mechanisms such as proffers, user fees, impact fees, and special taxing districts. - *6.* The County will direct the majority of public investments into currently developed communities, towns, and areas... - *Fire and Rescue Services Policies* – The County will require dry hydrants or tanks to be included in all new rural subdivisions of more than five dwelling units when no alternative water source is available on site. Chapter 5 – *The Green Infrastructure: Environmental, Natural, and Heritage Resources* - *Policies:*1. The County recognizes its Green Infrastructure as a collection of natural, cultural, heritage, environmental, protected, passive and active resources that will be integrated in a related system. ... It includes major rivers, stream corridors, floodplains and wetlands; lakes; ...steep slopes... - 3. The County recognizes that much of its Green Infrastructure is made up of natural resources that are fragile and irreplaceable and, therefore, will protect and preserve these resources in perpetuity. ...The watersheds are the key natural resource element in the Green Infrastructure and will be used as its primary organizing unit. - 8. The County will develop reasonable criteria for open-space dedications and will expect all landowners to dedicate land, or provide fees in lieu, for general open space and/or parks. These criteria will be designed to mitigate the impacts of their development... - *River and Stream Corridor Resources Policies:* 2. The County will protect rivers and streams and their corridors through the creation of a River and Stream Corridor Overlay District (RSCOD), which will include...100-year floodplains (including major and minor), adjacent steep slopes... - 3. A 100-foot minimum stream buffer will protect river and streams when the 100-year floodplain and adjacent steep slope areas do not extend beyond	

Jurisdiction	Plan Name	Date Adopted	Excerpts/Details of Document	Effect?
			either bank by 100 feet, and will be considered part of the RSCOD." - 16&17. Zoning ordinance, including Floodplain Overlay District and nonconforming use issues, will be amended. - 18. Permitted uses in RSCOD will not include residential or commercial uses. - 20. The County will maintain a working relationship with FEMA for continued participation in the NFIP. - *Surface and Groundwater Resources*: 16. The County will prepare and implement design standards and principles to preserve open space and natural resources, minimize the creation of new impervious areas and to minimize increases in post-development runoff peak rate, frequency and volume. - *Limestone Conglomerate Policies*: 2. Performance standards will be developed and applied to govern development on areas underlain by limestone because of a high potential for environmental damage, and to ensure public health and safety, including minimum setback distances from sinkholes, rock outcrops, and other Karst features. - 3. The County will limit development to large lot or clusters within the Limestone Conglomerate Overly District to avoid development in areas of identified Karst features. *Chapter 7 - Rural Policy Area* - *Green Infrastructure Policies* – 1. The County will develop and implement rural subdivision design regulations that address the location of houses on the landscape...and the protection of green infrastructure features such as...stream corridors, wetlands, steep slopes... - 4. The County will identify those properties that are not conducive to development due to sensitive environmental...characteristics, and promote their purchase through various programs. - 6. The County will encourage owners of 20 acres or more to avail themselves of the open space category of the Use Value Assessment Legislation by entering into voluntary contracts with the County requiring preservation of open space, particularly sensitive environmental areas such as river and stream corridors...and other areas designated as part of the County's Green Infrastructure. Chapter 8 – *Transition Policy Area* - *General Policies*: 2. The County's vision for the Transition Policy Area is for land uses that provide a visual and spatial transition between the urban development in the east and rural development in the west. ...establish natural open spaces as a predominant visual element and enhancement to the area's river and stream corridors. Chapter 9 – Growth Management Policies, Policy 10	

Jurisdiction	Plan Name	Date Adopted	Excerpts/Details of Document	Effect?
			- The County will coordinate with the Towns on development issues in order to promote fiscally balanced growth that will not unduly strain the natural environment. Chapter 11 – *Implementation* - *Open Space* – Open Space within a development will be obtained through conservation design and clustering…provides for the on-site transfer of density away from environmentally sensitive…areas.	
Prince William County	County of Prince William, Virginia Comprehensive Plan	8/4/1998 (amended through 8/1/2000)	*Overall Goals*: - Affordable, practical, and fiscally sound residential and economic development *Community Design* - DES-Policy 11 – Encourage innovative approaches to stormwater management. - DES-Policy 12 – Fit new development into natural landforms. (doesn't say floodplains but says drainage). *Environment* - *Goal* – Preserve, protect, and enhance the significant environmental resources and features of the County, including…soils, …biotic communities (stream corridors, forests, and wetlands)… - *EN-Policy 1* – Consider environmental concerns at all levels of land use-related decision-making (includes soils, steep slopes, 100-year floodplain boundary; requires description of "mitigation" effort). - *EN-Policy 2* – Increase the environmental awareness of county residents. - *EN-Policy 4* – Protect and manage the county's soils and natural vegetation. *Action strategies* – preclude development in areas with a dominance of marine clay soils, unless the applicant can demonstrate through geotechnical studies that all potential impacts, including those to structures, can and will be mitigated. - *EN-Policy 5* – Maintain or enhance the integrity of surface bodies of water and watersheds (deals with stream corridor protection and hazmat infiltration of watershed). - *EN-Policy 6* – Limit the amount and extent of impervious surfaces. - *EN-Policy 7* – Promote the preservation and use of natural ground surface features which facilitate the effective management of stormwater runoff. - *EN-Policy 8* – Ensure the protection of the county's groundwater and aquifers. *Strategies* include ensuring that any construction in a flood hazard district (identified by FEMA) is consistent with the Flood Hazard Overlay District and Chesapeake Bay Preservation Area Overlay District requirements, as identified in the Zoning Ordinance	Community Design – positive Environment - positive Public Facilities - neutral Long-Range Land Use - positive Parks and Open Space - neutral

Jurisdiction	Plan Name	Date Adopted	Excerpts/Status of Document	Effect
			and the Design and Construction Standards Manual (DCSM). Expansion of any nonconforming use or structure in a flood hazard district shall be permitted only as set forth in the zoning ordinance and DCSM. - *EN-Policy 11* – Preserve natural vegetation, especially existing and mature trees, and provide for the replacement of trees. *Public Facilities* - *Fire and rescue – Action strategies for new development* – Identify and seek service delivery improvements as mitigation measures at existing station locations through the development review process (they mean LOS mitigation). - *Action strategies - Site location and suitability standards* – Stations should not be located at the base of long or steep roadway grades. Soils should be suitable for construction without special preparation. *Long-Range Land Use* - *Goal* – to provide a pattern of land use Countywide that encourages fiscally sound development and achieves a high-quality living environment. - *Objective 5* – to protect environmentally sensitive land and maintain open space. - *Action strategies – 13. & 14.* allow cluster housing and the use of planned districts and planned unit development concept in the Development and Rural Areas....(open space gained through this process should be made permanent through easement). *Parks and Open Space* - *REC-Policy 2 – Action Strategy 5* – Encourage the use of conservation easements or restrictive covenants as appropriate, by private landowners in order to protect and preserve historic sites and sensitive environmental areas. - *REC-Policy 4 – Action Strategy 3* – Create designated stream valley (linear) parks to be incorporated into the County-wide trails and greenways system, to be provided through voluntary contributions by landowners or through Park Authority purchase of the land within the proposed stream valley park. *Action Strategy 13* – Encourage developers to collocate, where appropriate, trails and greenways within seer line easements, utility corridors, utility easements, and buffers alongside stream valleys and roads, to minimize land acquisition and disruption of the natural environment.	
Prince William County	Zoning Ordinance	October 22, 1991 (amended through	*Part 501. Flood Hazard Overlay District.* - Identifies sources for delineating floodplain (FEMA, ACOE, US Soil Conservation Service etc.); boundaries shown on Floodplain Map of Loudoun	Positive

Jurisdiction	Plan Name	Date Adopted	Excerpts/Details of Document	Effect?
		Oct. 17, 2000)	County – delineation made by text, map is reference. - 3 sub-districts (floodway, flood fringe, and approximated floodplain). - Flood hazard use permit required for all development in district. - Permitted uses: agricultural; industrial-commercial uses (surface loading and parking areas); private and public recreational uses (gold courses, basketball courts, etc.); residential (lawns, gardens, etc); roads, culverts, utility lines. Other uses and activities generally prohibited. - Describes criteria for variances. - Nonconforming uses subject to Sec 601.55. No alteration/addition/repair shall exceed 50% of appraised value in county assessment records unless becomes conforming use; if repair exceeds 20%, then floodplain ordinance requirements apply. No existing structures located in floodway should be expanded or enlarged below level of 100-year flood. If use discontinues for 12 months, subsequent use should conform to floodplain requirements. If nonconforming use or structure is destroyed by 50% or more, it shall not be reconstructed; if 20%, then must meet ordinance requirements (including elevation or floodproofing). Historic structures (state or national register) are exempt.	
City of Alexandria	Alexandria Waterfront Design Plan	1982?	- Calls for unified development of Alexandria Waterfront – including public open space and private commercial establishments. - Notes riprap in place at Jones Point Park, and seawall in place at south waterfront and encourages further uses of these as edge treatments. - Plan addresses streetscape and design elements more so than uses.	Negative
City of Alexandria	Zoning Ordinance	June 24, 1992	Intent of ordinance is to promote the health, safety and welfare of residents. Designed to: - Promote and regulate orderly growth, development, and redevelopment. - Promote, in the public interest, the utilization of the land for the purposes for which it is best adapted in harmony with the established character of the city. - To expedite the provision of adequate police and fire protection, disaster evacuation...flood protection...and other public requirements. - To protect against destruction or encroachment upon, historic areas and archeological sites. - To protect against...loss of life, health, or property from fire, flood, panic or other dangers. - To provide for the orderly preservation of environmentally sensitive areas and urban forested lands. *Article VI. Special and Overlay Zones (*Feb. 12, 2000)	General provisions – Positive Open Space – neutral Waterfront park and recreation zone – neutral Floodplain - positive. Noncomplyi ng structures-

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			- *Sec. 6-100:* POS/Public open space and community recreation zones. - Applies only to publicly owned open space, parks, etc. - Special uses include man-made lakes and similar public works projects (Nov.16, 2002 amendment) *Sec. 6-200:* WPR/Waterfront park and recreation zone (Feb. 12, 2000) - Permitted uses include public facilities and retail and/or services as accessory. - Special use includes restaurants. - Non-enumerated uses are prohibited (includes residential). - Setbacks required. - Open space requirement of 25%. - Utilities must be underground. *Sec. 6-300:* Floodplain District - Adopted Floodplain Map, dated May 15, 1991 as district map. - These regulations conform to FEMA regulations. - Requires review of all site plans, subdivision plats, and building permit applications that create substantial improvements within floodplain district – must meet ordinance requirements to be approved. - Within A and AE zones, elevation must be at or above 100-yr BFE. - Commercial structures can be floodproofed instead of elevated. - Variances allowed but must none allowed in floodway if increase 100-yr flood level. - Does not regulate uses. *Sec. 11-400:* Site plan. (Nov.16, 2002) - No "grade changes in excess of two feet within ten feet of adjacent land, or in excess of three feet elsewhere....or divert the flow of storm water or natural watercourses until a site plan has been submitted and approved." *Sec 12-100:* Noncomplying structures (Nov.16, 2002) - *12-102.* Noncomplying structures permitted to continue indefinitely but subject to following restrictions: reconstruction – if destroyed, demolished or otherwise removed, it may be reconstructed provided there is no increase in the FAR, density, height or degree of noncompliance which existed prior to such destruction. - *12-204.* Effect of damage to nonconforming use. If damage exceeds 60%+ of replacement value, must become conforming use. *Article XIII. Environmental Management (Chesapeake Bay Preservation)* (Feb. 9, 1993) - Prevents development in Resource Protection Areas unless water-dependent and allowed in	positive Site plans – neutral Chesapeake - positive

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			underlying zone. - RPAs include wetlands (tidal and nontidal), tidal shores, tributary streambeds and 100-feet buffers along these lands – does not include floodplain specifically. - Entire city in Resource Management Area – development must meet certain performance standards.	
City of Fairfax	Comprehensive Plan of the City of Fairfax, VA	November 29, 1988	City has floodplains, shrink-swell soils (which also contain asbestos). City zoning ordinances regulate development within the floodplain. Also regulate storm drainage and erosion control. *Environment – Objective:* encourage the retention of significant trees and other natural features, and the protection of important vistas. *Strategies:* Structure the City's development regulations to require that new development preserve existing natural features to the maximum extent possible. Encourage the planned development approach to maximize the retention of natural features. *Objective:* Monitor and abate environmental hazards to the maximum extent possible (radon/pollution/haz mat). *Community Appearance – Objective*: Improve the appearance of the major commercial corridors. *Strategy*: Eliminate distracting elements from the City's roadways (e.g., overhead wires). *Objective:* Encourage exemplary site and building design, construction and maintenance (e.g., clustering). *Land use – Objective:* preserve and enhance the City's residential neighborhoods as desirable places to live. *Strategy:* develop flexible zoning provisions to accommodate appropriate residential infill development (cites natural site constraints as one reason flexibility needed re: density increases).	Environment - positive Community Appearance – positive Land use - neutral
City of Fairfax	Zoning Ordinance	1993	*Ordinance 1993-8 amended Chapter 26, Article II, Divisions 2 and 3.* - Floodplain is area inundated by 100-year flood. - All development in floodplain has to comply with these regulations. - Need a floodplain permit before using floodplain. - Zoning administrator responsible for interpretation of boundaries. - Permitted uses – utilities and public facilities; by-right if impervious surfaces don't exceed 2500 sq ft – agricultural, outdoor recreational, parking area, and residential accessory. - Special use permit – those permitted by right if impervious surface exceeds 2500 sq ft. and any redevelopment of property. - Establishes review criteria for floodplain permit.	Positive
City of Falls Church	Draft Comprehensive Plan	August 15, 1997	*Community Character, Appearance, and Design* - *Goal #1, Strategy G:* Strengthen those portions of the City Code that protect applicable natural features and provide for adequate landscaping and screening	CCA&D – positive Land Use-

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			in the development and redevelopment of property (deals with tree preservation). - *Goal #5, Strategy D*: Create a greenway/natural park along Four Mile Run (deals with stream restoration). Implementation includes acquisition through fee simple, easement or eminent domain. *Land Use* - Overlay districts include floodplain and Chesapeake Bay. - *Floodplain Overlay District* – complies with NFIP requirements; restricts uses and development in all lands within the jurisdiction of the City identified as being in the 100-year floodplain. (Section 38-38 of Zoning Ordinance) - *Chesapeake Bay Preservation Area Overlay District* – conform with water quality protection and restoration requirements of CBPA, establishes RPAs that buffer streams and wetlands – only water dependent uses allowed. RMAs composed of 100 year floodplain – development within this area must meet performance standards re: erosion, impervious surfaces, and runoff. - *Goal 1* – Encourage development and redevelopment that is consistent with the Comprehensive Plan and its Land Use Map. - *Goal 1, Strategy D* – Analyze development proposals with respect to the carrying capacity of City facilities and infrastructure, including the development's impact on...stormwater management,...natural resources, and heritage. - *Goal1, Strategy F*: Encourage redevelopment that enhances the City's character while providing economic stability and environmental quality. - *Goal 1, Strategy I*: Revise the Zoning Ordinance to reflect principles of "sustainable development" as set forth in this document. - *Goal 3*: Pursue inter-jurisdictional cooperation on regional issues that have an impact on Falls Church. - *Goal 4*: Pursue land use and development that is consistent with the City's Watershed Management Plan, the Chesapeake Bay Act, and the environmental goals and strategies of the Comprehensive Plan. *Natural Resources* - Extensive public outreach services re: mulch/composting and recycling - City is primarily built out – emphasis on redevelopment of sites – need to address previously ignored environmental issues – map of physical constraints includes floodplain and soils - Recognizes need to address geology and soils to ensure safety of people and soundness of buildings – no specific soils map but identification of soil must happen at time of development/redevelopment; also includes discussion of need to avoid steep slopes	positive Natural Resources – positive Parks, Open Space and Recreation – positive Community Facilities, Public Utilities, and Government Services – positive Historic Preservation - neutral

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			(greater than 15%) - *Chesapeake Bay Protection - Goal 1:* Reduce the impacts of existing development on City streams, and protect the City's streams, and consequently, the Potomac River and Chesapeake Bay, from the avoidable impacts of new development. - *Goal 2:* Ensure the adequacy of the City's present and future stormwater management and drainage systems, while emphasizing the need to protect tributary streams and water quality. *Goal 2, Strategy B*: Design stormwater management structures and bioretention areas to control flooding, to protect water quality, and to provide for associated vegetative buffers. - *Goal 2, Strategy D*: Minimize the exposure of new development to the potential of flooding through enforcement of the City's flood control section of the Zoning Ordinance. - *Natural Resources Identification and Protection – Goal 1*: Identify natural resources that are important to the character of Falls Church, and develop programs and policies to protect and restore these features, such as natural stream banks, tress, and wildlife habitat. (strategies address collection of GIS data to track and identify resources) - *Goal 1, Strategy E:* Retain and protect mature trees in the City, and continue to implement tree planting, replacement, and maintenance program for public right of ways, easements, school grounds, and other municipally owned buildings… - *Goal 1, Strategy F* – Encourage private property owners to retain and protect mature trees and to continue tree planting, replacement, and maintenance programs. - *Goal 2:* Preserve and maintain existing parkland and open space, and pursue possibilities for the creation of additional open space for vegetative cover, water infiltration, and wildlife habitat. - *Goal 2, Strategy A* – Utilize floodplains and Chesapeake Bay Preservation Areas, where feasible, for parks and open space activities. - *Development – Goal*: Encourage development that is sensitive to the existing natural features of the City of Falls Church. - *Goal, Strategy D* – Encourage tree protect and replacement as part of the development process, and encourage site layout and design techniques to protect significant trees, streams, and other natural features. - *Citizen education and involvement – Goal:* educate and involve residents in environmental protection activities. - *Goal, Strategy A*: Work with and support citizen and business groups to implement environmentally beneficial projects. Identify financial and volunteer resources for environmental projects, such as restoration of denuded riparian areas…and the	

Jurisdiction	Plan Name	Date Adopted	Excerpts/Details of Document	Effect?
			stenciling of storm drains. - *Goal, Strategy B:* Use municipally owned land as a model for business and citizens for the protection and restoration of natural resources using the most environmentally sensitive techniques. *Parks, Open Space, and Recreation* - *Goal 2:* Maintain a high quality of existing parkland and open space. - *Goal 2, Strategy B:* Pursue possibilities for the acquisition of additional open space through the development process and actively pursue opportunities to acquire those parcels identified as top priority for parkland within the Recreation and Parks Advisory Board's recommendation (city uses proffers to obtain land unsuitable for development). - *Goal 2, Strategy D:* Consider maintain new parkland or open space areas in its natural state for passive recreational purposes. - *Goal 2, Strategy E:* minimize impervious surface in parks. *Community Facilities, Public Utilities, and Government Services* – *Public Safety, Goal 2:* Educate city residents about safety (includes personal and property). *Historic Preservation* - *Goal 2:* Preserve and enhance historic structures within the residential districts of the City, and recognize the aesthetic and economic value of preserving these structures (strategies deals with renovation and building codes). - *Goal 3:* Preserve and enhance historic resources located in non-residential zoning districts (strategies deal with renovation and adaptive reuse).	
City of Manassas	Comprehensive Plan	Feb. 1989, amendments 1994 and 2001	- Acknowledges land in 100-year floodplain but no environmental objective relates. - Includes land use classification for "Parks and Stream Valley Areas" – doesn't address floodplains specifically (sensitive environmental areas) - *Land Use Planning Concepts* – Residential areas should be reasonably free from potential hazards. - *Community Facility Policies* – Stream valley areas which carry more than the capacity of a 42 inch pipe under 100-year storm conditions should, to the maximum extent possible, be retained in their natural state.	Neutral/positive
City of Manassas	Subdivision Ordinance	Reprinted 1990	- *Sec 29-63* – Allows for dedication of land for public purposes including for stabilization of steep slopes and stormwater management - *Sec 29-66* – Certain land not to be platted for residential occupancy – land subject to flooding and deemed topographically unsuitable shall not be platted for residential occupancy. - *Sec 29-84* – Sets requirements for storm drainage and street drainage system	Positive

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City of Manassas	Zoning Ordinance	June 1, 1994	- *Sec. 34-35.* References Floodplain Management Ordinance – Chapter 10.1 of Code (Ord. of 6-12-79, Section III-2-4) - *Sec. 34-235.* Requires final site plan to include information re: location of fire hydrants and storm drainage system (including floodplain).	Positive
City of Manassas Park	Comprehensive Plan	2/17/1984 (amended 5/15/1990)	- *1990 Land Use Objective* – to direct growth, development, and public improvements in an orderly and cost-effective manner which may be supported by necessary financing of public services and facilities at a reasonable rate (through comp. plan, CIP, zoning and subdivision ordinance, and public hearings).	Neutral
City of Manassas Park	Subdivision Ordinance	October 1979	- Regulations require adequate provision for drainage and flood control and other public purposes, and for light and air - *6-3 Flooding* – Land subject to flooding and land deemed topographically unsuitable shall not be platted for residential occupancy, or for such other uses in such a way as to endanger health, life, or property, or aggravate erosion of flood hazards. Such land within the subdivision shall be set aside on the plat for uses as shall neither be endangered by periodic or occasional inundation nor produce conditions contrary to public welfare.	Positive
City of Manassas Park	Zoning Ordinance	February 1979 (current as of July 1993)	*Sec 31-21. FP Flood Plain District* - Districts include all areas subject to inundation by waters of the 100 year flood. - Defines floodway, floodway-fringe, approximated floodplain, and shallow floodplain districts. - Districts are overlays to existing zoning districts – more restrictive and/or floodplains apply when conflict exists. - Generally, all uses, activities and development occurring within any floodplain district shall be undertaken only upon issuance of a certificate of occupancy and/or upon approval of the required site plan. - Development should not adversely affect capacity of channels or floodways. - Floodway district – "no development shall be permitted except where the effect of such development on flood heights is fully offset by accompanying improvements which have been approved by all appropriate local and/or state authorities as required above." Permitted uses in floodway: agricultural, public and private recreational, accessory residential and accessory industrial and commercial. Special exception uses in floodway: Structures, except for mobile homes, accessory to permitted uses, utilities and public facilities, water-related uses and activities, temporary uses, storage of materials and equipments provided they are not buoyant, flammable, or explosive, and are not subject to major damage by flooding or if it is firmly anchored;	Positive

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			other similar uses and activities provided they do not cause no increase in flood heights and/or velocities. - Prohibited use in floodway – any mobile home. - Floodway fringe, approximated floodplain and shallow floodplain – uses in accordance with underlying district as long as floodproofed and in compliance with building code. - Describes criteria to be used in deciding special exceptions and variances. - Existing structures – shall not be enlarged or expanded; if modifications (include reconstruction) are less than 50% of market value shall be elevated and/or floodproofed; more than 50% of market value must be in full compliance with building code	
Town of Dumfries	Comprehensive Plan for the Town of Dumfries, Virginia	June 1993	*Land use* - *Goal F* – To assure maintenance of the Town's economic and fiscal viability. - *Goal G* – To insure that all land within the Town is developed in accordance with applicable Town ordinances and policies. *Environment* - *Goal A* – To maintain and enhance the natural features of the Town, protect the environment from degradation, and foster public awareness of the environment and its beauty. - *Objective 1* – Protect both the human environment and the natural environment, including water resources within and outside of the Town, form the impacts of development and urbanization. - *Strategies a* – Restrict improper development in floodplains associated with Quantico Creek and its tributaries. - *Strategies b* – Locate development away from environmentally sensitive wetlands and tidal waters. - *Strategies c* – Restrict improper and intensive development away from area with highly erodible soils, including steep slopes. - *Strategies g* – Encourage creative design principles during new development and in particular redevelopment to provide more functional open space, preserve sensitive areas, maintain maximum indigenous tree cover, and minimize impervious land cover for the desired and permitted land use. - *Strategies h* – Support conservation of appropriate land areas in a natural state in or to preserve, protect, and enhance stream valleys....through the use of conservation easements, setbacks, buffering, greenways, open space, and applicable Town ordinances including the Floodplain Overlay District and Chesapeake Bay Preservation Overlay District. - *Objective 3* – Ensure that new development either	Land Use – neutral Environment – positive

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			avoids problem soil area, or implements appropriate engineering measures to protect existing and new structures from unsuitable soils. - *Strategy a* – Limit densities on slippage soils, and cluster development away from slopes and potential problem areas. - *Strategy b* – Require new development on problem soils…to provide appropriate engineering measures to overcome potential problems. Encourage low density development on problem soils when this is a viable option for the permitted land use. - Town has Floodplain Overlay District to protect floodplains.	
Town of Dumfries	Town of Dumfries Zoning Ordinance	Reprint from 1990	*Sec 15-8 – Drainage* - No building shall be erected on any land and no change shall be made in the existing contours of any land…that will obstruct, interfere with, or substantially change the drainage from such land to the detriment of neighboring lands. [no adverse impact!] *Sec 15-36* - establishes zoning districts including FP-1 Floodplain. *Article X – Floodplain Districts FP-1* *Sec 15.252* – applies to all lands within 100-year floodplain - Applies to development after 8/1/1989. - District overlays existing underlying districts – floodplain district is a supplement to those districts – the more restrictive conditions or those related to floodplain apply. - Development within district requires zoning permit, the application for which requires site/project specific information including re: elevation, floodproofing. All mobile/manufactured homes have to be on permanent foundations and elevated and anchored. - Permitted uses in floodway: agricultural, public and private recreational, accessory residential and accessory industrial and commercial. Permitted uses in flood-fringe and approximated floodplain – all that are allowed in underlying as long as elevation or floodproofing can be shown. - Additional criteria cited for variances. - Nonconforming uses cannot be expanded or enlarged. *1995 amendments:* - If repairs, etc done exceed 65% of assessed value, must conform to elevation requirements. If uses become nuisances, shall not be permitted to continue. - All development must have proper permits from local, state and federal.	Positive

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			- Zoning administrator must determine the building site is reasonably safe from flooding before development is permitted. - Subdivision proposals must include BFE data. - All new construction and substantial improvements of residential shall be elevated to or above base flood level. Non-residential structures shall be elevated or floodproofed (wet or dry).	
Town of Herndon	2010 Comprehensive Plan	June 19, 1990	*I. Purpose* - To guide coordinated and harmonious physical development which will best promote the health, safety, prosperity and general welfare of Town residents. *Goals*: *Land Use* - To manage the effects of development so as to protect and enhance the Town's quality of life. - To work towards a balance between the natural and built environments. - To seek conservation and reclamation of natural resources within the Town. - To facilitate the safety and quality of life of neighborhoods (in terms of ...personal security and environmental quality) through consideration of the design and compatibility of adjoining uses. *Parks and Recreation* - To provide ample open space and access to natural area, with emphasis on natural park planning. *II. Land Use Plan* *Land Use designations:* - Adaptive Areas, encourages underground placement of utilities, minimization of impervious surfaces, provision of stormwater detention/retention structures, use of grass swales for surface drainage, and restoration of floodplain. - New development in floodplain is prohibited. - New development also needs to demonstrate that it will not exceed supply of public safety services (fire, EMS, etc). *Overlay Policies:* *Clean Streams*: - *Strategic objectives*: Update floodplain management regulations. - Includes floodplains in Resource Management Areas for purposes of Chesapeake Bay Preservation compliance. - Mitigate use of natural streams as collectors for urban stormwater sewage system. *Urban Forestry*: - *Strategic objective*: Establish program for planting and preservation of trees. - *Program components*: Continual budgeting for tree	Positive

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			planting, tree removal, and tree maintenance and care. *Redevelopment and Infill Guidance*: - *Strategic objective*: Create opportunities to improve the economic vitality,...safety of the built environment. - Evaluation guidelines include placement of utility lines underground, efforts to minimize impervious surfaces, provision of stormwater detention/retention, grass swales as surface drainage, and restoration of the floodplain. - Development within floodplain should be avoided. *III. Parks and Recreation Plan* - Goal of 25% overall open space. - Strategies include establishing a schedule for the acquisition of permanent public open spaces (p. 50). - As of 1990, 5 stream valley parks existed (Sugarland Run, Frying Pan Creek, Horsepen Run, Folly Lick Branch, and part of Little Difficult Run Branch) for total of 206 acres. *IV. Public Facilities* - Includes information re: storm sewer system improvements that will reduce flooding.	
Town of Herndon	Zoning Ordinance	Adopted October 26, 1971, and amended through March 18, 1998	*Article VIII. Floodplain Overlay District* - Include areas subject to inundation by waters of the 100-year flood - No development shall be permitted except where the effect of such development on flood heights is fully offset by accompanying improvements which have been approved by all appropriate local and/or state authorities - Permitted uses: agricultural uses; public and private recreational uses and activities; utilities and public facilities and improvements - Lays out criteria for deciding use permits - Nonconformities - Existing structures and/or uses located in the floodplain district shall not be expanded or enlarged unless mitigated. Repair et al of nonconforming use if less than 50% of its market value, shall be elevated and/or floodproofed to the greatest extent possible. Repair et al of nonconforming use if more than 50% of its market value, shall conform to building code.	Positive
Town of Leesburg	1997 Town Plan	August 12, 1997	- Identifies areas of steep slope and recognizes them as site constraints. Limestone conglomerate and potential sinkholes also identified as potential hazard. Problem soils include shrink-swell soils. - Town adheres to FEMA floodplain policies. *Goals* - To preserve and enhance natural resources to the extent practical, consistent with the character of the greater Leesburg area.	Positive

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			- To assure that development respects environmental factors that affect the quality of life of residents in the greater Leesburg area. *Objectives:* - Preserve vegetation and sensitive environmental features through the development process. - Discourage and carefully control development on steep slopes (greater than 25%). Limit development on moderately steep slopes (15-25 percent grade), promote use of County-recommended performance standards for where development occurs. - Minimize potential hazards to human health, the environment and property in the greater Limestone Conglomerate areas. Control building on unstable soils. - Preserve and use natural drainage ways wherever possible for stormwater management... - Encourage restoration of degraded natural areas and enhancement of existing natural areas to enable these areas to maximize their potential environmental value. - Preserve, expand, and enhance the tree population of Leesburg. *Policies:* - Existing topography, tree cover and other environmentally sensitive areas (e.g., streams, wetlands) should be used as key site planning elements in determining road layout, location and buffering of different land uses, stormwater management systems, and utility lines. - 5 policies dealing with steep slopes. - The town encourages and supports private and community programs to keep waterways free from debris and litter. - The town should preserve the 100-year floodplain of major streams such as Tuscarora Creek and Cattail Branch and encourage their incorporation into greenways and open space systems.	
Town of Leesburg	Town Plan 1986 (revised 1988)	March 26, 1986	*Environment* - Limited amount of steep slopes but greater amount of problem soils (shrink-swell, karst). - 111 acres inside Bypass are covered by Town's F-1 floodplain district; 450 acres annexed are covered by County floodplain district. - Floodplains are considered most appropriate for recreational and farm uses. Development is strictly limited in such areas... *Goal* - To preserve and enhance natural resources to the extent practical, consistent with the character of an area which is becoming urbanized. *Objectives* - Preserve and use stream valleys for recreation,	Environment – positive Community Facilities – positive Land Use - positive

Jurisdiction	Plan Name	Date Adopted	Excerpts/Details of Document	Effect?
			open space and flood control. Preserve and use natural drainageways wherever possible for stormwater management... *General Environmental Policies* 1.1 Town land use regulations should promote environmentally sensitive land planning and site design. *Sensitive Area Policies* 1.12 Development in problem soil and limestone areas should be subject to appropriate performance standards in order to minimize potential health and safety problems. 1.13 Preservation of slopes between 15% and 25% should be encouraged. *Critical Areas Policies* 1.15 Slopes greater than 25% should be preserved in their natural state to the maximum extent possible, allowing only appropriate uses such as passive recreation and necessary public facilities. 1.16 The town should preserve the 100-year floodplain of major streams such as Tuscarora Creek and Cattail Branch. *Action Program #2* – Establish a tree planting program and adopt a tree protection ordinance which would apply to all developments ('88 revision). *Action Program #8.* Consolidate town and county floodplain regulations. *Action Program #9.* Require preservation of slopes greater than 25% in proposed development wherever possible. *Community Facilities – Action program #12.* pursue acquisition of a stream valley park system along Tuscarora Creek and Cattail Branch. *Land Use* *Objectives* – develop land use regulations which ensure efficient, environmentally sensitive land use patterns in both small- and large-scale developments. *General Land Use Policies:* 5.3 New development should recognize and preserve the town's natural, historic and architectural resources for present and future residents. 5.15 The town's unique landscape should be recognized, preserved, and enhanced through the retention of natural features, including ridge lines, stream valleys... 5.16 Common open space in residential areas should perform multiple functions by providing recreational opportunities, visual relief and natural storm water retention. 5.76 The town should work with the private sector to preserve an open space/trail network based upon the W&OD corridor, stream valleys, and community facilities. 5.92 A continuous town open space/trail network should	

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			be developed incorporating stream valleys, natural drainageways and adjacent steep slopes...	
Town of Leesburg	Zoning Ordinance	February 25, 2003	*Article 5 – Overlay and Special District Regulations* *5C – F-1 Floodplain District* - No development shall be permitted in the Floodplain District except where the effects of such development on flood heights is fully offset by accompanying improvements which have been approved by all appropriate authorities. - The placement of any mobile home within the Floodplain District, except in an existing mobile home park or subdivision, is prohibited. - Permitted uses – agricultural, public and private recreational uses, accessory residential uses (e.g., gardens, play areas), and accessory industrial and commercial uses (e.g., pervious parking and loading areas). - Conditional uses – structures, except for mobile homes, accessory to the permitted uses and activities; utilities and public facilities/improvements such as bridges, streets, etc.; temporary uses (e.g., circuses); storage of materials and equipments provided they are not buoyant, flammable, or explosive, and are not subject to major damage by flooding or if it is firmly anchored; other similar uses and activities provided they do not cause no increase in flood heights and/or velocities. - Variances should consider affect on flood heights, susceptibility of proposed facility to flooding, availability of alternative locations and other flood-related factors. Variances, if granted, should include notification that constructing building below 100-year flood elevation could increase risk and increase insurance premiums. - Existing structures and/or uses located in the Floodplain District shall not be expanded or enlarged (unless risk can be offset). Modifications over 50% shall be elevated and/or flood-proofed; also must be in compliance with Uniform State Building Code.	Positive
Town of Purcellville	The Comprehensive Plan for the Town of Purcellville, Virginia	1998	*Land Use Goals* - To encourage a harmonious pattern of land use that will allow the Town to meet present and future community needs within prudent fiscal guidelines. This will stimulate physical, social and economic development while protecting the ecological balance, enhancing the Town's physical appearance and retaining its character. - *Objective 1* – Delineate land areas inside the Town limits which are best suited for conservation, residential, institutional, commercial and industrial activities in such a away as to separate incompatible uses and to minimize the impact of traffic. - Also notes need to protect the South Fork of the Catoctin Creek and its flood plain.	Land Use – neutral Economic Developme nt – neutral Environmen t - positive

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			- *Economic Development Goal 6* – Encourage businesses to use natural resources beneficially, protect environmental health and maintain the aesthetic quality of Purcellville. - *Environment Goal 1* – Improve, maintain, and protect the natural environment of the Town. Ensure that growth is nurturing to people but also safeguards the environment. Preserve the natural beauty and function of the environment as a habitat for people, plants and animals. - *Objective 2, Strategy a* – prohibit improper development in flood plains, including Catoctin Creek, through the enforcement of the Flood Plain Ordinance. *Strategy f* – develop a plan to assess the current storm water drainage system and develop strategies to correct deficiencies. - *Objective 3* – Protect the natural environment from inappropriate development and enhance the manmade environment through new zoning and subdivision ordinances using prevailing County, State, and Federal standards. - *Strategy d* – Develop a tree preservation and replacement plan… - *Strategy e* – Expand public ownership of open spaces and greenways within the Town when financially feasible. - Implementation tools include zoning, subdivision regulation, and the CIP.	
Town of Vienna	1988 Comprehensive Plan	January 23, 1989	*Objectives:* - Protect the integrity of natural stormwater drainage patterns such as the Wolftrap Stream Valley System. - Support replacement of utility lines in the commercial area with underground lines, particularly along Maple Avenue. *Specific recommendations*: The Town should strengthen its zoning provisions for preservation of natural storm-water drainage patterns. - Cites need to have master plan for water/sewer/stormwater. - Describes Stream Valley Parks – sizeable portion of Town's park system; provide storm drainage and buffers; master plan should be developed that includes stream bed care.	Positive
Town of Vienna	Zoning Ordinance	1/4/1982	*Vienna Flood Plain Ordinance* - Establishes flood plain and approximated flood plain districts - areas subject to inundation by waters of the one hundred (100) year flood. - Encroachment into the floodway should not result in result in any increase in the one hundred-year flood elevation. - Districts are overlays to existing districts. - All uses, activities, and development occurring	Positive

Jurisdiction	Plan Name	Date Adopted	Excerpts/Details of Document	Effect?
			within any Flood Plain District shall be undertaken only upon the issuance of a building permit. - In the Flood Plain District, no development shall be permitted except where the effect of such development on flood heights is fully offset by accompanying improvements which have been approved by all appropriate local and/or State authorities. - Uses – those of underlying district provided do not violate other parts of this ordinance. - Provides factors to consider when granting variances. - Nonconforming uses: Existing structures in the floodway district shall not be expanded or enlarged unless will not increase the 100-year flood elevation. Structures that are repaired et al for cost of less than fifty percent must be elevated or floodproofed. Structures that are repaired et al for cost of more than fifty percent must comply with building code. If uses become nuisances, shall not be permitted to continue. - *Flood Hazard Mitigation* (3-16-87) - Requires electric water heaters, electric furnaces and other critical electrical installations in floodplain to be elevated. Other vital appliances (i.e., HVAC) need to be designed to prevent water infiltration. - The preliminary plat requirements shall include a map showing the location of the proposed subdivision and/or land development with respect to any designated flood plain district... - For all new construction and substantial improvements, fully enclosed areas below the lowest floor that are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exist of floodwaters.	

MITIGATION STRATEGY

This section of the Plan provides the blueprint for the Northern Virginia region to follow in becoming less vulnerable to natural hazards. It is based on general consensus of the Northern Virginia Hazard Mitigation Planning Committee along with the findings and conclusions of the risk assessment and capability assessment. It consists of the following four subsections:

- Introduction
- Regional Mitigation Goals
- Identification and Analysis of Mitigation Techniques
- Selection of Mitigation Techniques for Northern Virginia

Introduction

The intent of the mitigation strategy is to provide NVRC and its local jurisdictions with the goals that will serve as the guiding principles for future hazard mitigation policy and project administration, along with a listing of proposed actions deemed necessary to meet those goals and reduce the impact of natural hazards. It is designed to be comprehensive and strategic in nature.

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

The first step in designing the mitigation strategy includes the identification of *regional mitigation goals*. Regional mitigation goals represent broad statements that are achieved through the implementation of more specific, action-oriented initiatives by the participating jurisdictions. These initiatives include both hazard mitigation policies (such as the regulation of land in known hazard areas through a local ordinance), and hazard mitigation projects that seek to address specifically targeted hazard risks (such as the acquisition and relocation of a repetitive loss structure).

The second step involves the identification, consideration and analysis of available mitigation measures to help achieve the identified mitigation goals. This is a long-term, continuous process sustained through the development and maintenance of this Plan, beginning with the cardstorming exercise for members of the Hazard Mitigation Planning Committee during the first Mitigation Strategy Workshop. Alternative mitigation measures will continue to be considered as future mitigation opportunities become identified, as data and technology improve, as mitigation funding becomes available, and as this Plan is updated and maintained over time.

The third and last step in designing the mitigation strategy is the creation of the local Mitigation Action Plans, which are provided separately in Section 9: *Mitigation Actions Plans*. The Mitigation Action Plans represent unambiguous plans for action, and are considered to be the most essential outcome of the mitigation planning process. They include a prioritized listing of proposed hazard mitigation actions (policies and projects) for each of Northern Virginia's local

jurisdictions along with accompanying information such as those agencies or individuals assigned responsibility for their implementation, potential funding sources and an estimated target date for completion. The Mitigation Action Plans provide those individuals or agencies responsible for implementing mitigation actions with a clear roadmap that also serves as an important tool for monitoring progress over time. The cohesive collection of actions listed in each jurisdiction's Mitigation Action Plan also can serve as an easily understood menu of mitigation policies and projects for those local decision makers who want to quickly review their jurisdiction's respective element of the Regional Plan.

In preparing their own individual Mitigation Action Plans, each jurisdiction considered their overall hazard risk and capability to mitigate natural hazards as recorded through the risk and capability assessment process, in addition to meeting the adopted regional mitigation goals and the unique needs of their community. Prioritizing mitigation actions for each jurisdiction was based on the following five (5) factors: (1) effect on overall risk to life and property; (2); ease of implementation; (3) political and community support; (4) a general economic cost/benefit review[1]; and (5) funding availability.

Regional Mitigation Goals

44 CFR Requirement

44 CFR Part 201.6(c)(3)(i): *The mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.*

The goals of the Northern Virginia Regional Hazard Mitigation Plan were crafted early in the planning process through a facilitated discussion and brainstorming session with the Hazard Mitigation Planning Committee (for more details, please see the summary of the second Hazard Mitigation Planning Committee meeting in Section 3: *Planning Process*). Each of the following goal statements represent a broad target for NVRC and its local participating jurisdictions to achieve through the implementation of their own specific Mitigation Actions Plans before the next Plan update.

Goal #1 **Improve the quality of *best available data* for conducting detailed hazard risk assessments and preparing meaningful mitigation action plans.**

Goal #2 **Increase the financial capability of local jurisdictions throughout the Northern Virginia region to implement hazard mitigation measures through maximizing grant funding opportunities as well as locally available fiscal resources.**

Goal #3 **Develop and maintain specific plans to minimize the potential affects of natural hazards, including the relevant local emergency preparedness, response and recovery plans.**

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

Goal #4 **Work to improve existing local policies, codes and regulations to reduce or eliminate the impacts of known natural hazards. This includes maintaining continued compliance with the National Flood Insurance Program (NFIP) for all participating jurisdictions.**

Goal #5 **Investigate and implement a range of structural projects that will reduce the effects of natural hazards on public and private property throughout the region.**

Goal #6 **Disseminate information to increase the general public's awareness of natural hazard risks in the Northern Virginia region, while also educating residents and businesses on the mitigation measures available to minimize those risks.**

Note: A stated objective of the Disaster Mitigation Act of 2000 is to improve the coordination of risk reduction measures between state and local government authorities. Linking local and state mitigation planning goals is an important first step. It has been determined by the Northern Virginia Hazard Mitigation Planning Committee that the above goal statements should be consistent with the State of Virginia's current mitigation planning goals, and will be revised as necessary during future Plan updates in coordination with the Virginia Division of Emergency Management.

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 Program[2] (EMAP):

44 CFR Requirement

44 CFR Part 201.6(c)(3)(ii): *The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effect of each hazard, with particular emphasis on new and existing buildings and infrastructure.*

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

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

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

1. 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
- Shoreline / riverine / fault zone setbacks

2. 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
- Insurance

3. 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
- Slope stabilization

4. 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
- Storm sewers

5. 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
- Installing temporary shutters for wind protection

6. 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
- Hazard expositions

Selection of Mitigation Techniques for Northern Virginia

In order to determine the most appropriate mitigation techniques for the Northern Virginia region, local government officials reviewed and considered the findings of the risk assessment and the capability assessment. Other considerations included each individual mitigation action's effect on overall risk to life and property, its ease of implementation, its degree of political and community support, its general cost-effectiveness, and funding availability (if necessary).

FEMA guidance for meeting the planning requirements of the Disaster Mitigation Act of 2000 also specifies that local governments should prioritize their mitigation actions based on the level of risk a hazard poses to the lives and property of a given jurisdiction. In response to this requirement, a Mitigation Technique Matrix (**Figure 8.1**) was completed to make certain the Northern Virginia Hazard Mitigation Planning Committee addressed, at a minimum, those hazards posing the greatest threat. The matrix provides the committee with the opportunity to cross-reference each of the priority hazards (as determined by through the risk assessment) with the aforementioned comprehensive range available mitigation techniques, including prevention; property protection; natural resource protection; structural projects; emergency services; and public education and awareness. However, it is important to note that the individual Mitigation Action Plans (Section 9) include an array of actions targeting multiple hazards, not just those classified as either high or moderate risk.

Figure 8.1
Mitigation Technique Matrix

MITIGATION TECHNIQUE	HIGH RISK HAZARDS				MODERATE RISK HAZARDS		
	Flood	Severe T'storms	Tornadoes	Winter Storms	Hurricanes & Tropical Storms	Drought	Wildfire
Prevention	✓	✓	✓	✓	✓	✓	✓
Property Protection	✓	✓	✓	✓	✓	✓	✓
Natural Resource Protection	✓	✓	✓	✓	✓		✓
Structural Projects	✓	✓	✓		✓		
Emergency Services	✓	✓	✓	✓	✓	✓	✓
Public Education & Awareness	✓	✓	✓	✓	✓	✓	✓

Mitigation Action Plans

The mitigation actions developed and adopted by participating jurisdictions are listed in Section 9: *Mitigation Action Plans*. **Table 8.1** illustrates the general format in which each mitigation action was recorded and documented for each jurisdiction's plan. Though specific to each individual jurisdiction, each action has been designed to achieve the broader goals identified in Northern Virginia's regional mitigation strategy. By identifying specific projects and policies, the local Mitigation Action Plans help lay the framework for participating counties and municipalities to engage in distinct actions or initiatives that will reduce their exposure to future hazard events and disasters.

Table 8.1
Mitigation Action Worksheet

Mitigation Action	
Community Name:	
Action Item (Describe):	
Category:	
Hazard(s):	
Lead Agency/ Department Responsible:	
Estimated Cost:	
Funding Method:	
Implementation Schedule:	
Priority:	

Instructions for completing the Mitigation Action Worksheet:

a. **Community Name:** Be sure to identify your community's name.

b. **Action Item:** Identify a specific action that, if accomplished, will reduce vulnerability and risk in the impact area. Actions may be in the form of local policies (e.g., regulatory or incentive-based measures), programs or structural mitigation projects and should be consistent with any pre-identified mitigation goals and objectives.

c. **Category:** Indicate the most appropriate category for the proposed action (Prevention; Property Protection; Natural Resource Protection; Structural Projects; Emergency Services; or Public Education and Awareness). Refer to the "Categories for Mitigation Actions" handout for description of each category.

d. **Hazard(s):** List the hazard(s) the proposed action is designed to mitigate against.

e. **Lead Agency/ Department Responsible:** Identify the local agency, department or organization that is best suited to implement the proposed action.

f. **Estimated Cost:** If applicable, indicate what the total cost will be to accomplish this action. This amount will, of course, have to be an estimate until actual final dollar amounts can be determined. Some actions (such as ordinance revisions) may only cost "local staff time" and should be noted so.

g. **Funding Method:** If applicable, indicate how the cost to complete the action will be funded. For example, funds may be provided from existing operating budgets or general funds, a previously established contingency fund, a cost-sharing federal or state grant program, etc.

h. **Implementation Schedule:** Indicate when the action will begin and when the action is expected to be completed. Remember that some actions will require only a minimum amount of time, while others may require a long-term or continuous effort.

i. **Priority:** Indicate whether the action is a "high" priority, "moderate" priority or "low" priority. Prioritization should be based on the following:

1. Effect on overall risk to life and property.
2. Ease of implementation.
3. Project costs vs. benefits
4. Political and community support.
5. Funding availability.

MITIGATION ACTION PLANS

Mitigation Action Plans

The mitigation actions proposed by NVRC and each of Northern Virginia's participating local jurisdictions are listed in fourteen (15) individual Mitigation Action Plans on the pages that follow. Each MAP has been designed to address the established regional goals of this Hazard Mitigation Plan, in addition to the particular goals and objectives of each individual jurisdiction. They will be maintained on a regular basis according to the plan maintenance procedures established for the Northern Virginia Regional Hazard Mitigation Plan (See Section 10: *Plan Maintenance Procedures*).

44 CFR Requirement

44 CFR Part 201.6(c)(3)(iii): *The mitigation strategy shall include an action plan describing how the actions identified in paragraph (c)(2)(ii) of this section will be prioritized, implemented, and administered by the local jurisdiction.*

Jurisdiction	# of Mitigation Actions
Northern Virginia Regional Commission	1
Arlington County	7
Fairfax County	63
Loudoun County	8
Prince William County	9
Alexandria	8
Fairfax	7
Falls Church	8
Manassas	10
Manassas Park	9
Dumfries	7
Herndon	11
Leesburg	4
Purcellville	6
Vienna	7

44 CFR Requirement

44 CFR Part 201.6(c)(3)(iv): *For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit for the plan.*

Northern Virginia Regional Commission

NVRC Mitigation Action 1	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.
Category:	Planning
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Regional Planning Services
Estimated Cost:	$100,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	2006 – 2007
Priority (High, Moderate, Low):	High

Arlington County

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
High			✓
Moderate			
Limited			

Arlington County Mitigation Action 1	Upgrade County EOC to modern standards.
Category:	Planning
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of Emergency Management
Estimated Cost:	$1,500,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	12 months from time of award
Priority (High, Moderate, Low):	High

Arlington County Mitigation Action 2	Develop government Continuity of Operations (Coop) plans.
Category:	Mitigation
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of Emergency Management
Estimated Cost:	$350,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	12 months from time of award
Priority (High, Moderate, Low):	High

Arlington County Mitigation Action 3	Develop model evacuation and shelter-in-place plans for government.
Category:	Planning
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of Emergency Management
Estimated Cost:	$200,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	12 months from time of award
Priority (High, Moderate, Low):	High

Arlington County Mitigation Action 4	Implement modern public warning siren system.
Category:	Mitigation
Hazard(S) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of Emergency Management
Estimated Cost:	$900,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	12 months from time of award
Priority (High, Moderate, Low):	High

Arlington County Mitigation Action 5	Implement 211/311 citizen information line.
Category:	Mitigation
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of Emergency Management
Estimated Cost:	$6,000,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	24 months from time of award
Priority (High, Moderate, Low):	Medium

Arlington County Mitigation Action 6	Certify addition shelter capacity.
Category:	Planning
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of Emergency Management
Estimated Cost:	$200,000
Potential Funding Sources:	N/A
Implementation Schedule:	12 months from time of award
Priority (High, Moderate, Low):	Medium

Arlington County Mitigation Action 7	Train employees as Incident Management and Incident Support Teams (IMT/IST).
Category:	Training
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of Emergency Management
Estimated Cost:	$150,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	18 months from time of award
Priority (High, Moderate, Low):	Medium

Fairfax County

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
High			✓
Moderate			
Limited			

Fairfax County Mitigation Action 1	Development of a comprehensive River Flood Response System for the New Alexandria, Belle View and Huntington areas in partnership with the National Weather Service and the U.S. Army Corps of Engineers.
Category:	Emergency Services
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	$30,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 2	Portable generators for backup power at remote command posts, remote park locations, on vehicles.
Category:	Property Protection Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$15,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 3	Fairfax County is in the process of implementing a Community Alert Network (CEAN) for an emergency text notification system for the residents/visitors of Fairfax County. Important information and emergency information will be disseminated in a timely manner from Emergency Management staff, with the assistance of the Office of Public Affairs through a wireless base software system to e-mail addresses, pagers, cell phones, blackberries and other mobile type devises. This will be a voluntary no-cost system that the citizens can register for and maintain their own personal data. We anticipate rolling out this project in the first quarter of 2005 with the approval of the Fairfax County Board of Supervisors (BOS). This will be in addition to many other notification mediums that Fairfax County Office of Public Affairs now uses.
Category:	Emergency Services
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Office of Emergency Management in conjunction with the Office of Public Affairs
Estimated Cost:	Not sure at this time but would be calculated at the cost per license time 800,000 residents
Potential Funding Sources:	Combination of general funds and grant funding
Implementation Schedule:	Q1 2006
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 4	Rescue responder kits.
Category:	Property Protection Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$5,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 5	Cellular phones/2-way Nextel phones/pagers for park field staff.
Category:	Property Protection Structural Projects Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Blizzard, Thunderstorm
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$50,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 6	Evacuation fans to move large volumes of air quickly from confined spaces to remove potentially hazardous air.
Category:	Property Protection Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Blizzard, Thunderstorm
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$40,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 7	Dam stabilization repairs at Lake Accotink park.
Category:	Property Protection Natural Resource Protection Structural Projects
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Thunderstorm, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$500,000
Potential Funding Sources:	Pending voter approval of 2004 Park Bond Referendum
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 8	Dam stabilization repairs at Twin Lakes Golf Course.
Category:	Property Protection Natural Resource Protection Structural Projects
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Thunderstorm, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$500,000
Potential Funding Sources:	Pending voter approval of 2004 Park Bond Referendum
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 9	Streambank stabilization/erosion control countywide in Park Authority stream valley parks.
Category:	Natural Resource Protection
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Thunderstorm, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$2,000,000
Potential Funding Sources:	U.S. Department of Agriculture, Natural Resource Conservation Service: Emergency Watershed Protection; U.S. Army Corps of Engineers: Emergency Streambank and Shoreline Protection, Small Flood Control Projects
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 10	Roof repairs to Park Authority structures at Grist Mill Barn, Oak Marr RECenter and Spring Hill RECenter.
Category:	Property Protection Structural Projects
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Thunderstorm, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$680,000
Potential Funding Sources:	Identified need but currently unfunded—possible project in 2008 Park Bond Referendum
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 11	Purchase and decommissioning of 17 below ground condominium units located inside the 25-year floodplain of the Potomac River.
Category:	Property Protection
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	$140,000 per unit
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	These purchases may have to be negotiated at the time the units become available on the market
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 12	Annual or bi-annual outreach to residents and businesses in the New Alexandria/Baileview areas within the 100-year floodplain. Emergency preparedness training and emergency communications/evacuation procedures.
Category:	Public Education and Awareness
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	Local staff time plus mailing and printing costs
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA)
Implementation Schedule:	Spring 2006
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 13	Elevate to elevation 11.5 NGVD29 approximately 85 single family residences in New Alexandria with first floor elevations lower than the 50-year flood elevation of the Potomac River. (i.e., currently lower than 9.7 NGVD29).
Category:	Property Protection
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	Average of $170,000 per structure x 85 structures = $14,500,000
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	To be determined. This option to be pursued if U.S. Army Corps of Engineer's study this coming year determines floodwall construction or other structural protection to be infeasible. (Pursue funding for several dwellings per year, prioritizing by lot—i.e., by lottery of interested homeowners).
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 14	Installation of remote lake level data collectors/alarms for the 14 of the 15 state-regulated dams in the county that are high hazard. (Only one of the 15 has an alarm system currently.) Acquisition of software and hardware to transmit this lake-level data to the Stormwater Planning Division and Emergency Management.
Category:	Emergency Services
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	$350,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 15	Retrofitting six (6) high-hazard state-regulated dams to adequately pass the Freeboard Hydrograph flood without overtopping the dam.
Category:	Structural Projects
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	$5,000,000
Potential Funding Sources:	U.S. Army Corps of Engineers: Flood Control Works / Emergency Rehabilitation
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 16	Repairs to New Alexandria Stormwater Pump Station and Tide Gate.
Category:	Structural Improvements
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	$130,000
Potential Funding Sources:	U.S. Army Corps of Engineers: Flood Control Works / Emergency Rehabilitation
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 17	Continue the mapping of private wells in Fairfax County with Global Positioning System (GPS) technology. The collected data will be used to create a geographic information system (GIS) database which will allow the Health Department to quickly and precisely identify groundwater wells that could be impacted by flooding or contamination incidents such as spills.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$300,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be complete Spring 2006
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 18	Initiate a countywide project to collect global positions data for all food establishments. The collected data will be used to create a geographic information system database which will allow the Health Department to quickly and precisely identify affected establishments due to flooding, power outages and sewage back-ups from natural disasters.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	Approximately $54,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To begin Spring 2006
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 19	Medical Reserve Corp volunteer recruitment, including printing, mailings and meetings.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$100,000
Potential Funding Sources:	Future funding to be determined
Implementation Schedule:	Began 2004
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 20	Development of four (4) online training modules for Medical Reserve Corps volunteers.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$160,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP); U.S. Department of Health and Human Services Grants (various)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 21	Development of NIMS ICS training that is public health-specific for Health Department staff.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$40,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP); U.S. Department of Health and Human Services Grants (various)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 22	Stockpile and/or establish contracts for rapid delivery of critical supplies and equipment needed for the first 72 hours of an emergency and storage space to supplement the County Warehouse.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$100,000
Potential Funding Sources:	Future funding to be determined
Implementation Schedule:	Began 2004
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 23	Establish one (1) Management Analyst II position to coordinate Medical Reserve Corps volunteer recruitment and training (includes fringe benefits).
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$83,578 annually
Potential Funding Sources:	Future funding to be determined
Implementation Schedule:	Began Spring 2004 for one year
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 24	Establish one (1) Management Analyst II position to manage the Medical Reserve Corps volunteer database (includes fringe benefits).
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$72, 593
Potential Funding Sources:	Future funding to be determined
Implementation Schedule:	Began Spring 2004 for one year
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 21	Development of NIMS ICS training that is public health-specific for Health Department staff.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$40,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP); U.S. Department of Health and Human Services Grants (various)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 22	Stockpile and/or establish contracts for rapid delivery of critical supplies and equipment needed for the first 72 hours of an emergency and storage space to supplement the County Warehouse.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$100,000
Potential Funding Sources:	Future funding to be determined
Implementation Schedule:	Began 2004
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 23	Establish one (1) Management Analyst II position to coordinate Medical Reserve Corps volunteer recruitment and training (includes fringe benefits).
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$83,578 annually
Potential Funding Sources:	Future funding to be determined
Implementation Schedule:	Began Spring 2004 for one year
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 24	Establish one (1) Management Analyst II position to manage the Medical Reserve Corps volunteer database (includes fringe benefits).
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$72, 593
Potential Funding Sources:	Future funding to be determined
Implementation Schedule:	Began Spring 2004 for one year
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 25	Establish one (1) Administrative Assistant III to support the Fairfax Medical Reserve Corp program (includes fringe benefits).
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$47,761 annually
Potential Funding Sources:	Future funding to be determined
Implementation Schedule:	Began Spring 2004 for one year
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 26	Forest stand delineation surveys in riparian areas within stream valley parks. Removal of hazardous trees that could damage public or private property adjacent to these parklands.
Category:	Property Protection Natural Resource Protection
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Thunderstorm, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$500,000
Potential Funding Sources:	To be determined
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 27	Flood protection structures—Riverbend Park Visitor Center
Category:	Property Protection Structural Projects
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Thunderstorm, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$200,000
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant Program (PDM)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 28	Land acquisition—floodplains, Resource Protection Areas
Category:	Natural Resource Protection
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Thunderstorm, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$10,000,000
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant Program (PDM), Flood Mitigation Assistance Program (FMA); U.S. Department of the Interior, National Park Service: Land and Water Conservation Fund Grants
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 29	Digitized mapping, integrated with GIS, of flood-prone areas of stream valleys. Use data to identify potential parcels for acquisition.
Category:	Natural Resource Protection
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Thunderstorm, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$50,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP); Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 30	Seek voluntary buyouts for acquisition of three properties along Accotink Drive which are FEMA repetitive loss properties within the 100-year floodplain.
Category:	Property Protection
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	$1,200,000
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 31	Outreach and education project to residents living in the dam breach zones of the county's state-regulated dams.
Category:	Public Education and Awareness
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	Local staff time plus mailing and printing costs
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Pilot project—Dam site #4—Lake Royal (Winter 2006)
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 32	Construction of a diversion conduit/channel system to carry flows from the "East Watershed" in the New Alexandria subdivision to the pump station in the "West Watershed" during weather events when high tides cause the tide gate to close and high rainfalls accumulate on the upstream side of the tidegate.
Category:	Structural Projects
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	$350,000 (cost plus contingency for soil stabilization of these soils that have proven extremely difficult to excavate in this subdivision in several past projects)
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program; U.S. Department of Agriculture, Natural Resource Conservation Service: Emergency Watershed Protection, Watershed Protection and Flood Protection; U.S. Army Corps of Engineers: Small Flood Control Projects
Implementation Schedule:	Survey and hydraulic/hydrologic study—Winter 2006 Preliminary Design—Spring 2006 Public Coordination and Final Design—Summer 2006 Construction—Fall 2006/Winter 2007
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 33	Acquisition of house on Park Road in 100-year floodplain
Category:	Property Protection
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	Approximately $750,000
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 34	Installation of two (2) rain gauges, one in the headwaters of Pohick Creek watershed, near four high hazard, state-regulated earth dams, and one further south in the same watershed, close to two other high hazard, state-regulated dams and one large earthen dam owned by the Virginia Game and Inland Fisheries. Acquire software and hardware to have this real-time rainfall data transmitted to Stormwater Planning Division, DPWES and Emergency Management.
Category:	Emergency Services
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works and Environmental Services
Estimated Cost:	$25,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 35	Initiate a countywide project to collect global positioning data for all regulated public establishments such as hotels, nursing homes and clinics. The collected data will be used to create a geographic information system (GIS) database that will allow the Health Department to quickly and precisely identify affected establishments due to flooding, power outages and sewage back-ups from natural disasters.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	To be determined
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 36	Initiate a countywide project to collect global positioning data for mapping private septic systems. The collected data will be used to create a geographic information system (GIS) database that will allow the Health Department to quickly and precisely identify affected septic systems due to flooding.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	Not known due to multiple variables in the mapping
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 37	Implement a blast fax and/or e-mail system that would allow information such as a boil water notice to be disseminated expeditiously to regulated establishments during a natural disaster. To include one (1) limited term S-12 position to support the implementation.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	Approximately $32,500
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 38	Production, printing and distribution costs associated with public outreach educational materials in multiple medias such as radio, TV, fliers, newsprint and Web sites. To include standardized news releases for flooding of food establishments and other buildings. Information to include salvage of cans, time requirement for boil water, mold issues, communicable disease issues, etc.
Category:	Public Education and Awareness
Hazard(s) Addressed:	All Hazards, Especially Flooding
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	Not known
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 39	Pre-wire of the portion of the Health Administration Building housing the ACC to accept a mobile generator in the event of an electricity outage during an emergency.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$75,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 40	One (1) limited term position for nine months to identify critical facilities with respect to public water service areas using GIS.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$38,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 41	Pre-position contract(s) to meet staffing needs related to recovery and coincident conduct of essential services. Basically, backfill contact with temporary agencies to maintain essential services during recovery.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$50,000
Potential Funding Sources:	To be determined
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 42	Portable devices that permit wireless data transmission to/from the field during an emergency, especially to support dispensing site operations.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$200,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 43	Portable air monitors to measure plume outfall at varying distances from the source so that concentrations can be measured and exposure determined.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	Not known
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 44	Construct a permanent shelter for the public at the county-owned Woodley Hills Estates project, which is a trailer/mobile home facility. There currently is no on-site safe area for residents to evacuate to in the event of any type of natural disaster.
Category:	Property Protection
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Department of Housing and Community Development
Estimated Cost:	$750,000
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Pre-Disaster Mitigation Grant Program (PDM); U.S. Department of Housing and Urban Development: Community Development Block Grant; other federal or state grant program(s); funds currently unavailable in the general fund
Implementation Schedule:	FY 2006—planning, FY 2007—construction should funding become available
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 45	Update GIS contours—current contours are almost eight years old; however, the county has undergone substantial change since then. These contours will be important for a range of flooding determinations, to augment the FEMA DFIRM maps. This project will increase the resolution and accuracy of the contours in the process. Currently, the old contours are 5'. This will provide 2' contours.
Category:	Prevention and Property Protection
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	DIT jointly with DPWES
Estimated Cost:	$60,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action46	Installation of surveillance cameras and security systems at nine (9) Park Authority RECenters.
Category:	Property Protection
Hazard(s) Addressed:	Hurricane, Tornado, Flooding
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$210,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 47	Backup emergency generators (200amp) for nine (9) RECenters.
Category:	Property Protection Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$900,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 48	Training requirements—recognizing dangers, shelter-in-place guidelines, emergency response training.
Category:	Prevention Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$25,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 49	AED Units and associated training—30 locations required.
Category:	Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Blizzard
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$150,000 30 required—$5,000 per
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 50	Rescue boats for three (3) lakefront parks and Riverbend park.
Category:	Property Protection Structural Projects Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Thunderstorm
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$100,000 4 boats at $25,000 per
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 51	Equipment required for debris removal—chainsaws, shippers, trailers, utility vehicles for two (2) crews, north and south county.
Category:	Property Protection Structural Projects Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Blizzard, Thunderstorm
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$65,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 52	Bucket truck to address hazardous trees and other aerial dangers.
Category:	Property Protection Natural Resource Protection Structural Project Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Blizzard, Thunderstorm
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$100,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 53	Crane required to remove large downed trees, washed out bridges, other large debris.
Category:	Property Protection Natural Resource Protection Structural Projects Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Blizzard, Thunderstorm
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$150,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 54	Generators to provide power to protect wildlife and farm animals at Park Authority Nature Centers and Frying Pan Park.
Category:	Property Protection Emergency Services
Hazard(s) Addressed:	Hurricane, Tornado, Flooding, Blizzard, Thunderstorm
Lead Agency/Department Responsible:	Fairfax County Park Authority
Estimated Cost:	$24,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Fairfax County Mitigation Action 55	Command post vehicle and related staff training.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Health Department
Estimated Cost:	$275,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Low

Fairfax County Mitigation Action 56	Equipment Purchase – Emergency Generator
Category:	Emergency Services/Shelters
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Police Department Animal Control
Estimated Cost:	$70,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 57	Equipment Purchase – Foul Weather Gear (400 Rain suits and over boots)
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of the Sheriff
Estimated Cost:	$16,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 58	Equipment Purchase – Traffic Control Equipment (400 Reflective vests and gloves)
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of the Sheriff
Estimated Cost:	$14,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 59	Emergency Services – Emergency Vehicles (2 Gator Utility Vehicles)
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of the Sheriff
Estimated Cost:	$18,600
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 60	Emergency Services Equipment – (25 Chain saws and accessories)
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of the Sheriff
Estimated Cost:	$6,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 61	Emergency Services Equipment – (20 Thermos Cans)
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of the Sheriff
Estimated Cost:	$2,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 62	Emergency Services Equipment – (30 Emergency Vehicle Light Sets)
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of the Sheriff
Estimated Cost:	$6,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Fairfax County Mitigation Action 63	Emergency Services Equipment – (30 First Aid Kits)
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Office of the Sheriff
Estimated Cost:	$5,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Loudoun County

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
High			✓
Moderate			
Limited			

Loudoun County Mitigation Action 1	Provide back-up power (generators) for critical facilities (i.e., fire stations, police stations, water facilities, shelters, etc.).
Category:	Property Protection
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	Public Works
Estimated Cost:	$5,000,000 approximately
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP); Buffer Zone Protection Program (BZPP)
Implementation Schedule:	Time schedule is dependent on funding source and availability
Priority (High, Moderate, Low):	High

Loudoun County Mitigation Action 2	Improve drainage in low-lying or poor drainage areas along primary and secondary roads countywide. During heavy rain events several area roadways become inundated with water runoff and make traveling difficult.
Category:	Structural Projects
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	VDOT and Public Works
Estimated Cost:	Unknown (Assessment Required)
Potential Funding Sources:	Coordinate with Virginia Department of Transportation (VDOT); general fund; bond revenues
Implementation Schedule:	Undetermined at this point—based on funding availability
Priority (High, Moderate, Low):	High

Loudoun County Mitigation Action 3	Installation of traffic signal UPS or generator systems at key intersections. During times of power failure, law enforcement personnel are deployed for extended periods of time directing traffic. The installation of these power backup systems would provide law enforcement personnel the opportunity to conduct other necessary functions.
Category:	Property Protection
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	VDOT, Town Public Works, Law Enforcement
Estimated Cost:	$10,000,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Transit Security Grant Program (TSGP)
Implementation Schedule:	Undetermined at this time—dependent on funding source and availability
Priority (High, Moderate, Low):	High

Loudoun County Mitigation Action 4	Install IFLOW gauges along several waterways to assist with determining flood potential and to provide real-time data back to the Emergency Operations Center (EOC).
Category:	Structural Projects
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	National Weather Service and Emergency Management
Estimated Cost:	$75,000
Potential Funding Sources:	U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service
Implementation Schedule:	Undetermined at this point—based on funding availability
Priority (High, Moderate, Low):	High

Loudoun County Mitigation Action 5	Provide emergency broadcast information in multiple languages. Loudoun County has a growing population of non-English speaking residents and visitors. By providing information in multiple languages the County will be able to, in a timely manner, warn the community and provide emergency information.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Emergency Management, Emergency Communications and Public Information
Estimated Cost:	$50,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Undetermined at this time—dependent on funding source and availability
Priority (High, Moderate, Low):	Moderate

Loudoun County Mitigation Action 6	Enhancement of security measures around critical facilities to include the Emergency Operations Center (EOC).
Category:	Property Protection
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	County Administration
Estimated Cost:	$5,000,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Buffer Zone Protection Program (BZPP)
Implementation Schedule:	Undetermined at this time—dependent on funding source and availability
Priority (High, Moderate, Low):	Moderate

Loudoun County Mitigation Action 7	Conduct an all hazard community outreach program to provide emergency preparedness information regarding susceptible hazards and action steps when they occur. This program would be tailored in different languages to ensure adequate dissemination throughout the community.
Category:	Public Information
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	Emergency Management and Public Information
Estimated Cost:	$100,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Undetermined at this time—dependent on funding source and availability
Priority (High, Moderate, Low):	Moderate

Loudoun County Mitigation Action 8	Enhance, update and regularly maintain high quality aerial photography of the county. During times of large-scale emergency or disaster situations having the ability to see before and after photos is extremely helpful. In the planning process aerial photography also provides useful insight.
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Planning and Emergency Management
Estimated Cost:	$75,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Undetermined at this time—dependent on funding source and availability
Priority (High, Moderate, Low):	Moderate

Prince William County

OVERALL CAPABILITY	HAZARD RISK		
	Low	Moderate	High
High			✓
Moderate			
Limited			

Prince William County Mitigation Action 1	Providing security for the Police vehicles at the Garfield Police precinct. The security would be in the form of a chain link fence.
Category:	Property protection
Hazard(s) Addressed:	Theft and/or damage by vandalism
Lead Agency/Department Responsible:	Public Works
Estimated Cost:	$50,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Dependent on funding
Priority (High, Moderate, Low):	High

Prince William County Mitigation Action 2	Provide generators for critical facilities and shelters.
Category:	Property Protection
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Public Works
Estimated Cost:	$4,000,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Dependant on funding
Priority (High, Moderate, Low):	High

Prince William County

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
High			✓
Moderate			
Limited			

Prince William County Mitigation Action 1	Providing security for the Police vehicles at the Garfield Police precinct. The security would be in the form of a chain link fence.
Category:	Property protection
Hazard(s) Addressed:	Theft and/or damage by vandalism
Lead Agency/Department Responsible:	Public Works
Estimated Cost:	$50,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Dependent on funding
Priority (High, Moderate, Low):	High

Prince William County Mitigation Action 2	Provide generators for critical facilities and shelters.
Category:	Property Protection
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Public Works
Estimated Cost:	$4,000,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Dependant on funding
Priority (High, Moderate, Low):	High

Prince William County Mitigation Action 3	Open Space Management Plan.
Category:	Prevention
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Planning Department
Estimated Cost:	$50,000
Potential Funding Sources:	U.S. Department of the Interior, National Park Service: Land and Water Conservation Grants; U.S. Department of Agriculture, Natural Resource Conservation Service: Watershed Protection and Flood Prevention
Implementation Schedule:	Dependant on funding
Priority (High, Moderate, Low):	High

Prince William County Mitigation Action 4	Warning system for the Town of Occoquan. This will include the system and the evacuation plan.
Category:	Emergency Services
Hazard(s) Addressed:	Flooding caused by dam failure
Lead Agency/Department Responsible:	Public Works/Fairfax Water Authority
Estimated Cost:	$200,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Dependant on funding
Priority (High, Moderate, Low):	High

Prince William County Mitigation Action 5	Have a contractor update and revise the Flood Insurance Rate Map (FIRM).
Category:	Property Protection
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Planning
Estimated Cost:	$100,000
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Map Modernization Program / Cooperating Technical Community (CTC)
Implementation Schedule:	Dependant on funding
Priority (High, Moderate, Low):	High

Prince William County Mitigation Action 6	Traffic Signal UPS Systems.
Category:	Property Protection
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	VDOT/County Police
Estimated Cost:	$5,000,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Transit Security Grant Program (TSGP)
Implementation Schedule:	Dependant on funding
Priority (High, Moderate, Low):	Moderate

Prince William County Mitigation Action 7	Have a consultant determine mitigation efforts for County buildings.
Category:	Prevention
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Public Works and Emergency Management
Estimated Cost:	$150,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Buffer Zone Protection Program (BZPP); Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program; U.S. Department of Commerce, Economic Development Administration: Disaster Mitigation and Technical Assistance Grants
Implementation Schedule:	Dependant on funding
Priority (High, Moderate, Low):	Moderate

Prince William County Mitigation Action 8	Variable message signs.
Category:	Emergency Services
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Police/Public Affairs
Estimated Cost:	$200,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Transit Security Grant Program (TSGP)
Implementation Schedule:	Dependant on funding
Priority (High, Moderate, Low):	Moderate

Prince William County Mitigation Action 9	Provide weather updates from NOAA in Spanish. Prince William County has a growing population of non-English speaking persons living in the county. NOAA weather radios are the most reliable means of getting weather watch and warning information.
Category:	Emergency services
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Emergency Management/PSCC
Estimated Cost:	$50,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Dependant on funding
Priority (High, Moderate, Low):	Moderate

City of Alexandria

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
			✓
Moderate			
Limited			

City of Alexandria Mitigation Action 1	Revise Flood Insurance Rate Map (FIRM).
Category:	Public Education and Awareness
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Transportation and Environmental Services (T&ES)
Estimated Cost:	$10,000+
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Map Modernization Program / Cooperating Technical Community (CTC)
Implementation Schedule:	Contingent upon funding
Priority (High, Moderate, Low):	High

City of Alexandria Mitigation Action 2	Separate combined sanitary and storm sewers.
Category:	Structural Project
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Transportation and Environmental Services (T&ES)
Estimated Cost:	$60 million
Potential Funding Sources:	To be determined
Implementation Schedule:	Contingent upon funding
Priority (High, Moderate, Low):	High

City of Alexandria Mitigation Action 3	Enact state law to allow recreation lake/dam to be used for flood control.
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	City Attorney
Estimated Cost:	Staff Time Only
Potential Funding Sources:	N/A
Implementation Schedule:	ASAP
Priority (High, Moderate, Low):	High

City of Alexandria Mitigation Action 4	Install backflow prevention valves on properties in Commonwealth interceptor service area and four-mile run sewer service area.
Category:	Property Protection
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Transportation and Environmental Services (T&ES)
Estimated Cost:	$1 million
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP); Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	Contingent upon funding
Priority (High, Moderate, Low):	Moderate

City of Alexandria Mitigation Action 5	Acquire flood-prone properties and create public open space.
Category:	Property Protection
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	City Attorney
Estimated Cost:	$10 million
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program; U.S. Department of the Interior, National Park Service: Land and Water Conservation Fund Grants
Implementation Schedule:	Contingent upon funding
Priority (High, Moderate, Low):	Moderate

City of Alexandria Mitigation Action 6	Elevate structures that have history of repetitive losses recorded by the NFIP.
Category:	Property Protection
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Transportation and Environmental Services (T&ES)
Estimated Cost:	$10 million
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	Contingent upon funding
Priority (High, Moderate, Low):	Moderate

City of Alexandria Mitigation Action 7	Purchase and distribute free of charge a NOAA weather radio for each of the current 1,594 flood insurance policy holders.
Category:	Emergency Services
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Emergency Management
Estimated Cost:	$100,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP); Federal Emergency Management Agency: Hazard Mitigation Grant Program (HMGP)
Implementation Schedule:	Contingent upon funding
Priority (High, Moderate, Low):	Moderate

City of Alexandria Mitigation Action 8	Purchase and install Mobile Public Address System in all city-marked fleet vehicles for warning enhancement.
Category:	Emergency Services
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	General Services
Estimated Cost:	$50,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Contingent upon funding
Priority (High, Moderate, Low):	Low

City of Fairfax

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
[illegible]		✓	
Moderate			
Limited			

City of Fairfax Mitigation Action 1	Complete job description and hire full time staff person to support the emergency management function in the City of Fairfax. At present, the emergency management duties are carried out as collateral duties by the Fire Chief and Assistant Fire Chief. The availability of a full time staff member dedicated to this function would enhance our emergency preparedness.
Category:	Prevention, Emergency Services, Public Education and Awareness
Hazard(s) Addressed:	All
Lead Agency/Department Responsible:	Fire Department
Estimated Cost:	$80,000—$100,000 per year (salary and benefits, vehicle, office space, telephone, etc.)
Potential Funding Sources:	General fund or grant funded position
Implementation Schedule:	Within six months of funding approval
Priority (High, Moderate, Low):	High

City of Fairfax Mitigation Action 2	Stormwater management and stream restoration projects on the North and Central Forks of Accotink Creek, design, clearing and maintenance to prevent flooding. This project has been identified in the Capital Improvement Program (CIP).
Category:	Property protection, natural resource protection
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Public Works
Estimated Cost:	$380,000
Potential Funding Sources:	City capital improvement program; U.S. Department of Agriculture, Natural Resource Conservation Service: Emergency Watershed Protection; U.S. Army Corps of Engineers: Emergency Streambank and Shoreline Protection, Small Flood Control Projects
Implementation Schedule:	Completed by July 2007
Priority (High, Moderate, Low):	High

City of Fairfax Mitigation Action 3	Install electronic message boards at three (3) locations in the city. These message boards would be used to convey information to motorists regarding emergency conditions, pending severe weather and road closings. This project has been identified in the Capital Improvement Program (CIP).
Category:	Public Education and Awareness/Emergency Services (Warning System)
Hazard(s) Addressed:	All
Lead Agency/Department Responsible:	Public Works
Estimated Cost:	$250,000
Potential Funding Sources:	Capital Improvement Program (CIP); U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Six months after availability of funds
Priority (High, Moderate, Low):	Moderate

City of Fairfax Mitigation Action 4	Perform self-evaluation of Office of Code Administration in accordance with the Building Code Effectiveness Grading Schedule and implement where possible changes leading to an improvement in score on next formal evaluation by ISO. (Current score = 4, goal = 3).
Category:	Prevention
Hazard(s) Addressed:	Wind, Flood, Tornado, Hurricane, Fire
Lead Agency/Department Responsible:	Office of Code Administration/Fire
Estimated Cost:	Local staff time
Potential Funding Sources:	General fund
Implementation Schedule:	Complete by December 2006
Priority (High, Moderate, Low):	Moderate

City of Fairfax Mitigation Action 5	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.
Category:	Emergency Services
Hazard(s) Addressed:	All
Lead Agency/Department Responsible:	Fire Department and Police Department
Estimated Cost:	$250,000—$400,000
Potential Funding Sources:	City capital improvement project; U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	18 months after availability of funds
Priority (High, Moderate, Low):	Moderate

City of Fairfax Mitigation Action 6	Create a GIS layer showing future land use throughout city.
Category:	Prevention
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Community Development & Planning/Information Technology
Estimated Cost:	Local staff time or contractor at approximately $20,000
Potential Funding Sources:	General fund for staff or grant funding to pay contractor
Implementation Schedule:	12 months
Priority (High, Moderate, Low):	Moderate

City of Fairfax Mitigation Action 7	The City of Fairfax does not currently participate in the NFIP's Community Rating System (CRS). This project would consist of carrying out the steps necessary to begin participation by the City of Fairfax in the CRS program.
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Community Development & Planning
Estimated Cost:	Local staff time or use of consultant resources at $50,000
Potential Funding Sources:	General fund for city staff, possible grant funding for consultant
Implementation Schedule:	One year after initiation of project
Priority (High, Moderate, Low):	Moderate

City of Falls Church

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
High		✓	
Moderate			
Limited			

City of Falls Church Mitigation Action 1	Evacuation planning and management
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Public Safety
Estimated Cost:	$50,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	12 Months from time of award
Priority (High, Moderate, Low):	High

City of Falls Church Mitigation Action 2	Warning Systems: AM radio system
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Public Safety
Estimated Cost:	$45,000 to $55,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	12 Months from time of award
Priority (High, Moderate, Low):	High

City of Falls Church Mitigation Action 3	Critical facilities protection: Physical security of all water system facilities and system
Category:	Property Protection
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Department of Environmental Services
Estimated Cost:	$1,200,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Buffer Zone Protection Program (BZPP); U.S. Environmental Protection Agency: Vulnerability Assessments and Related Security Improvements at Large Drinking Water Utilities
Implementation Schedule:	24 Months from time of award
Priority (High, Moderate, Low):	High

City of Falls Church Mitigation Action 4	Critical facilities protection: Water system storage tank monitoring system.
Category:	Property Protection
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Department of Environmental Services
Estimated Cost:	$700,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Buffer Zone Protection Program (BZPP); U.S. Environmental Protection Agency: Vulnerability Assessments and Related Security Improvements at Large Drinking Water Utilities
Implementation Schedule:	24 Months from time of award
Priority (High, Moderate, Low):	High

City of Falls Church Mitigation Action 5	Drainage system maintenance
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Department of Environmental Services
Estimated Cost:	$400,000
Potential Funding Sources:	To be determined
Implementation Schedule:	24 Months from the time of award
Priority (High, Moderate, Low):	Moderate

City of Falls Church Mitigation Action 6	Stormwater Management Regulations
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Department of Environmental Services
Estimated Cost:	$200,000
Potential Funding Sources:	To be determined
Implementation Schedule:	12 Months from the time of award
Priority (High, Moderate, Low):	Moderate

City of Falls Church Mitigation Action 7	Emergency response training and exercises
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Public Safety
Estimated Cost:	$24,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	12 Months from time of award
Priority (High, Moderate, Low):	Moderate

City of Falls Church Mitigation Action 8	Floodplain regulations
Category:	Prevention
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Department of Environmental Services
Estimated Cost:	$100,000
Potential Funding Sources:	To be determined
Implementation Schedule:	12 Months from the time of award
Priority (High, Moderate, Low):	Low

City of Manassas

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
High			✓
Moderate			
Limited			

City of Manassas Mitigation Action 1	Update and revise the Flood Insurance Rate Map (FIRM).
Category:	Property Protection
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Engineering and Mapping – Department of Public Works
Estimated Cost:	$75,000
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Map Modernization Program / Cooperating Technical Community (CTC)
Implementation Schedule:	12 months upon funding
Priority (High, Moderate, Low):	High

City of Manassas Mitigation Action 2	Drainage Project – Retrofit and convert two (2) existing storm water management ponds into Regional Storm Water Management Ponds.
Category:	Natural Resource Protection, Property Protection, and Structural Projects
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$970,000
Potential Funding Sources:	U.S. Department of Agriculture, Natural Resource Conservation Service: Emergency Watershed Protection, Watershed Protection and Flood Prevention; U.S. Army Corps of Engineers: Small Flood Control Projects
Implementation Schedule:	Immediately upon receipt of funding
Priority (High, Moderate, Low):	High

City of Manassas Mitigation Action 3	GIS Mapping Upgrade: This project will upgrade our existing GIS technology and hardware and hire a contractor to convert our existing static maps into the GIS system. The static maps include the Zoning, Comprehensive Plan, Storm water Management, and Open Space Maps.
Category:	Prevention
Hazard(s) Addressed:	Flooding, Wind Damage
Lead Agency/Department Responsible:	Mapping and Engineering – Department of Public Works, and Community Development Office
Estimated Cost:	$350,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Immediately upon receipt of funding
Priority (High, Moderate, Low):	High

City of Manassas Mitigation Action 4	Comprehensive Aerial Mapping: This project will hire a contractor(s) to update our aerial mapping of the City of Manassas. The contractor(s) will provide the aerial mapping data in a format that will be compatible with the GIS mapping system. This data will be use to identify flood areas, storm water management ponds, water flow and tree coverage.
Category:	Prevention
Hazard(s) Addressed:	Flooding, Wind Damage
Lead Agency/Department Responsible:	Mapping and Engineering – Department of Public Works, and Community Development Office
Estimated Cost:	$100,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Immediately upon receipt of funding
Priority (High, Moderate, Low):	High

City of Manassas Mitigation Action 5	Undergrounding of overhead electric distribution facilities operated by the City of Manassas Utilities Department. The City of Manassas operates its own electric distribution services to residents and businesses of Manassas. Currently, the Electric Department has 79% of all distribution facilities below ground. This project will underground the remaining 21% of the distribution facilities. Upon completion to the City of Manassas will have 100% of its distribution facilities below ground and safe from many natural hazards.
Category:	Property Protection, Emergency Services and Structural Projects
Hazard(s) Addressed:	All Hazards including wind damage, and critical infrastructure
Lead Agency/Department Responsible:	Utilities – Electric Department
Estimated Cost:	$4,000,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Buffer Zone Protection Program (BZPP)
Implementation Schedule:	Upon receipt of funding
Priority (High, Moderate, Low):	High

City of Manassas Mitigation Action 6	Design, construction and purchase of either mobile or fixed electric generators at several drinking water pumping stations. This project will put into place the capability to generate electricity through alternative methods in the event of a prolonged power outage. The generators can either be fixed or mobile. The pumping stations are part of the drinking water critical infrastructure for the City of Manassas.
Category:	Property Protection and Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Utilities – Water Department
Estimated Cost:	$150,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Buffer Zone Protection Program (BZPP); U.S. Environmental Protection Agency: Vulnerability Assessments and Related Security Improvements at Large Drinking Water Utilities
Implementation Schedule:	Immediately upon receipt of funding
Priority (High, Moderate, Low):	High

City of Manassas Mitigation Action 7	Traffic Signal – Uninterruptible Power Supply (UPS). This project will continue to add alternative power sources to several key traffic signals in the City of Manassas.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Public Works – Traffic Controls
Estimated Cost:	$100,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Transit Security Grant Program (TSGP)
Implementation Schedule:	Immediately upon receipt of funding
Priority (High, Moderate, Low):	High

City of Manassas Mitigation Action 8	Variable Traffic Message Signs: This project will add several traffic message boards to the inventory of the City of Manassas. 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.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Public Works – Street Department
Estimated Cost:	$60,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Immediately upon receipt of funding
Priority (High, Moderate, Low):	Moderate

City of Manassas Mitigation Action 9	Variable Traffic Message Signs This project will add several traffic message boards to the inventory of the City of Manassas. 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.
Category:	Emergency Services
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Public Works – Street Department
Estimated Cost:	$60,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Transit Security Grant Program (TSGP)
Implementation Schedule:	Immediately upon receipt of funding
Priority (High, Moderate, Low):	Moderate

City of Manassas Mitigation Action 10	Hire a contractor to create a CPTED Design Manual
Category:	Prevention and Public Education / Awareness
Hazard(s) Addressed:	Flooding, Wind Damage and General Safety
Lead Agency/Department Responsible:	Community Development Office
Estimated Cost:	$20,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Immediately upon receipt of funding
Priority (High, Moderate, Low):	Low to Moderate

City of Manassas Park

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
[illegible]		✓	
Moderate			
Limited			

City of Manassas Park Mitigation Action 1	Capitol improvement project to widen roads to make them more readily accessible to emergency services vehicles in the Haver Hill Apartment Complex.
Category:	Prevention
Hazard(s) Addressed:	Fire
Lead Agency/Department Responsible:	Planning and Zoning
Estimated Cost:	$1.5 million
Potential Funding Sources:	Local
Implementation Schedule:	18 months
Priority (High, Moderate, Low):	High

City of Manassas Park Mitigation Action 2	Install and implement mobile infrared transmitters (M.I.R.T.) to allow emergency services response to pass through steady red traffic signals during an emergency response to any hazard.
Category:	Emergency Services (Emergency Response)
Hazard(s) Addressed:	All
Lead Agency/Department Responsible:	Public Works
Estimated Cost:	Unknown
Potential Funding Sources:	Local; U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	12 months
Priority (High, Moderate, Low):	High

City of Manassas Park Mitigation Action 3	Install comprehensive video surveillance system to protect public buildings and VRE Station from terrorist attacks (Bombings, derailments, etc.) to be continuously monitored.
Category:	Property Protection (Protection against loss of life and injury)
Hazard(s) Addressed:	Terrorism
Lead Agency/Department Responsible:	Public Works, Police, Fire
Estimated Cost:	$300,000
Potential Funding Sources:	Local; U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Buffer Zone Protection Program (BZPP)
Implementation Schedule:	12 months
Priority (High, Moderate, Low):	High

City of Manassas Park Mitigation Action 4	Update evacuation and emergency management plan for gas pipeline rupture, and practice drill.
Category:	Emergency Services (Evacuation planning and management)
Hazard(s) Addressed:	Gas Pipeline Rupture
Lead Agency/Department Responsible:	Fire, Police, Public Works
Estimated Cost:	$5,000
Potential Funding Sources:	Local; U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Six months
Priority (High, Moderate, Low):	High

City of Manassas Park Mitigation Action 5	Practical Emergency Operations Training Exercise on a citywide basis for a natural disaster.
Category:	Emergency Services
Hazard(s) Addressed:	All Natural Disasters (Fire, Flood, Hurricane, Earthquake, etc).
Lead Agency/Department Responsible:	Police, Fire and Public Works (All Agencies)
Estimated Cost:	$10,000
Potential Funding Sources:	Local; U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Six months
Priority (High, Moderate, Low):	High

City of Manassas Park Mitigation Action 6	Increase efforts to educate the public on natural and manmade hazards that threaten the City of Manassas Park.
Category:	Public Education and Awareness
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Emergency Management
Estimated Cost:	$2,000
Potential Funding Sources:	Operating budgets; grants; ARC (in-kind contributions)
Implementation Schedule:	12 months
Priority (High, Moderate, Low):	High

City of Manassas Park Mitigation Action 7	Practical exercise to include a practice fire evacuation drill for school aged children, for use at home as well as school.
Category:	Public Education and Awareness
Hazard(s) Addressed:	Fire
Lead Agency/Department Responsible:	Fire, Police
Estimated Cost:	$2,000
Potential Funding Sources:	Local; U.S. Department of Homeland Security, Federal Emergency Management Agency, U.S. Fire Administration: Assistance to Firefighters Grant Program
Implementation Schedule:	Three months
Priority (High, Moderate, Low):	Moderate to High

City of Manassas Park Mitigation Action 8	Fortify existing infrastructure (install "Jersey Barriers"), to minimize property loss, loss of life and injury in the event of a train derailment.
Category:	Property Protection
Hazard(s) Addressed:	VRE Train Derailment
Lead Agency/Department Responsible:	Engineering Contractors
Estimated Cost:	$1 Million
Potential Funding Sources:	Local; U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	12 months
Priority (High, Moderate, Low):	Moderate

City of Manassas Park Mitigation Action 9	Stabilize the slope and prevent erosion at Haverhill Apartment Complex and Railroad Drive. (Fortify the existing structure with a retaining wall).
Category:	Natural Resource Protection
Hazard(s) Addressed:	Erosion
Lead Agency/Department Responsible:	Public Works
Estimated Cost:	$200,000—$500,000
Potential Funding Sources:	Local
Implementation Schedule:	Six months
Priority (High, Moderate, Low):	Low

Town of Dumfries

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
High			
Moderate		✓	
Limited			

Town of Dumfries Mitigation Action 1	Emergency relocation of Police Department.
Category:	Property Protection
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Police Department
Estimated Cost:	$10,000
Potential Funding Sources:	Town of Dumfries Unscheduled Expenses/VDEM; U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP), Buffer Zone Protection Program (BZPP); Federal Emergency Management Agency: Pre-Disaster Mitigation Grant Program (PDM); Hazard Mitigation Grant Program (HMGP)
Implementation Schedule:	Dependent on funding
Priority (High, Moderate, Low):	Moderate

Town of Dumfries Mitigation Action 2	Storm sewers on Washington Street.
Category:	Structural Projects
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$300,000
Potential Funding Sources:	VRA funding
Implementation Schedule:	Dependent on funding
Priority (High, Moderate, Low):	Moderate

Town of Dumfries Mitigation Action 3	Storm sewers on Tripoli Boulevard.
Category:	Structural Projects
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$1.3 million
Potential Funding Sources:	VRA funding/VDOT funding
Implementation Schedule:	Dependent on funding
Priority (High, Moderate, Low):	Moderate

Town of Dumfries Mitigation Action 4	Storm sewers on Duke/Cameron Street
Category:	Structural Projects
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$400,000
Potential Funding Sources:	VRA funding
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	Moderate

Town of Dumfries Mitigation Action 5	Sandbagging for flood protection of Town Hall/Police Department
Category:	Emergency Services
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$50,000
Potential Funding Sources:	VDEM/FEMA
Implementation Schedule:	Dependent on funding
Priority (High, Moderate, Low):	Moderate

Town of Dumfries Mitigation Action 6	Quantico Creek Restoration.
Category:	Natural Resource Protection
Hazard(s) Addressed:	
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$405,000
Potential Funding Sources:	VRA funding; U.S. Department of Agriculture, Natural Resource Conservation Service: Emergency Watershed Protection; U.S. Army Corps of Engineers: Emergency Streambank and Shoreline Protection, Small Flood Control Projects
Implementation Schedule:	Dependent on funding
Priority (High, Moderate, Low):	Moderate

Town of Dumfries Mitigation Action 7	Storm sewers on Town Hall Parking Lot.
Category:	Structural Projects
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$150,000
Potential Funding Sources:	VRA funding
Implementation Schedule:	Dependent on funding
Priority (High, Moderate, Low):	Moderate

Town of Herndon

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
High		✓	
Moderate			
Limited			

Town of Herndon Mitigation Action 1	Improve Town's participation in FEMA and National Flood Insurance Program (NFIP) programs to include: 1. Involvement in NFIP Community Rating System (CRS) 2. Complete and maintain FEMA Elevation Certificates 3. Sign a Cooperative Technical Partner (CTP) agreement with FEMA 4. Coordinate the Town's GIS with the HAZUS-MH® software program
Category:	Prevention
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Department of Public Works Department of Community Development
Estimated Cost:	$100,000 (local staff time)
Potential Funding Sources:	Local Funds; Environmental Systems Research Institute (ESRI); U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	Contingent upon funding availability Anticipated schedule: 2007
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 2	Maintain and inspect the Town's infrastructure so that any potential environmental hazard may be minimized. Such maintenance items may include: 1. Routinely clean and repair stormwater drains 2. Routinely inspect and clear debris from drainage system 3. Routinely inspect the functioning of fire hydrants 4. Require and maintain safe access for fire apparatus
Category:	Prevention
Hazard(s) Addressed:	Multiple (Primarily Flood, Fire)
Lead Agency/Department Responsible:	Department of Public Works Fairfax County Fire Department
Estimated Cost:	$50,000/year (Local staff time)
Potential Funding Sources:	Local
Implementation Schedule:	Continuous action item
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 3	Provide for improvements to the Town's natural infrastructure so that flooding hazards may be minimized. Such items may include: 1. Provide grassy swales along roadside 2. Retain natural vegetative bed in stormwater channels 3. Substitute porous surfaces/pavement for impervious pavement where appropriate 4. Using stream restoration/channelization to ensure adequate drainage diversion of stormwater 5. Establishing a "green infrastructure" program to link, manage and expand existing parks, open space, trails, preserves, etc.
Category:	Structural Projects Infrastructure (sub-category)
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$100,000/year (local staff time)
Potential Funding Sources:	Local; U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	Continuous action item Contingent upon funding availability
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 4	Improve the Town's geographic information system (GIS) capabilities to include: 1. Coordination of GIS data between the Town and adjacent counties (i.e., Fairfax County and Loudoun County) 2. Updating FEMA floodplain data and maps 3. Preparing emergency evacuation maps 4. Updating aerial photography 5. Preparing/updating land use, soils, topography, resource protection maps 6. Preparing HAZUS-MH® risk assessment maps
Category:	Prevention
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Department of Public Works Department of Community Development and coordination with Fairfax County's GIS Department
Estimated Cost:	Start-up costs: $200,000 Annual Cost: $100,000 (local staff time)
Potential Funding Sources:	Local Funds; Environmental Systems Research Institute (ESRI); U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	Contingent upon funding availability Anticipated Schedule: 2007
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 5	Provide for a full-time Emergency Management Coordinator. This position would involve managing inter-departmental coordination for the Town's Hazard Mitigation Program. This position would also be responsible for managing and coordinating the Town's emergency grant programs.
Category:	Prevention Management Practices
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Police Department; inter-departmental function
Estimated Cost:	$70,000/year (salary, benefits, computer, phone, misc.)
Potential Funding Sources:	Local General Funds; grant funds
Implementation Schedule:	Contingent upon funding availability
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 4	Improve the Town's geographic information system (GIS) capabilities to include: 1. Coordination of GIS data between the Town and adjacent counties (i.e., Fairfax County and Loudoun County) 2. Updating FEMA floodplain data and maps 3. Preparing emergency evacuation maps 4. Updating aerial photography 5. Preparing/updating land use, soils, topography, resource protection maps 6. Preparing HAZUS-MH® risk assessment maps
Category:	Prevention
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Department of Public Works Department of Community Development and coordination with Fairfax County's GIS Department
Estimated Cost:	Start-up costs: $200,000 Annual Cost: $100,000 (local staff time)
Potential Funding Sources:	Local Funds; Environmental Systems Research Institute (ESRI); U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	Contingent upon funding availability Anticipated Schedule: 2007
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 5	Provide for a full-time Emergency Management Coordinator. This position would involve managing inter-departmental coordination for the Town's Hazard Mitigation Program. This position would also be responsible for managing and coordinating the Town's emergency grant programs.
Category:	Prevention Management Practices
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Police Department; inter-departmental function
Estimated Cost:	$70,000/year (salary, benefits, computer, phone, misc.)
Potential Funding Sources:	Local General Funds; grant funds
Implementation Schedule:	Contingent upon funding availability
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 6	Develop a townwide "Early Warning System" for hazard events to include: 1. 'Continuity of Operations Plan' 2. Improvements to the employee notification network and its protocols 3. Obtaining 'Reverse 911© system' software, hardware and peripheral equipment 4. 4-wheel drive vehicles with applicable communications and equipment (i.e., command post vehicle for mobile incidents)
Category:	Prevention Management Practices
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Inter-departmental function
Estimated Cost:	$150,000 (Local staff time)
Potential Funding Sources:	Local; U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	Continuous action item Contingent upon funding availability
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 7	Provide for natural resource protection improvements and other measures to minimize flooding impacts. Such improvements may include: 1. Regularly clear sediment build-up along stream beds 2. Regularly clear debris along stream beds 3. Retain thick vegetative cover flanking stream beds
Category:	Natural Resource Protection Prevention (sub-category)
Hazard(s) Addressed:	Flood
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	Annual Cost: $50,000 Local staff time
Potential Funding Sources:	Local; U.S. Department of Agriculture, Natural Resource Conservation Service: Emergency Watershed Protection; U.S. Army Corps of Engineers: Emergency Streambank and Shoreline Protection, Small Flood Control Projects
Implementation Schedule:	Continuous yearly action Contingent upon funding availability
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 8	Develop improvements to the Building Code (and promote its enforcement) so that environmental hazards may minimize damage to structures. For example: 1. Require fire extinguishers in all multi-family residential structures 2. Require standard tie-downs of propane tanks
Category:	Prevention Land Use/Design/Codes (Sub-Category)
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	Local staff time
Potential Funding Sources:	Local
Implementation Schedule:	To be determined
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 9	Provide for structural improvements to the Town's infrastructure so that environmental hazards may be minimized. Such items include: 1. Install quick connect emergency generator hook-ups for critical facilities 2. Increase dimension of drainage culverts in troublesome areas 3. Install water tight covers or inflow guards on sewer manholes 4. Anchor traffic lights and other traffic controls to withstand high winds 5. Substitute porous surfaces/pavement for impervious pavement where appropriate
Category:	Structural Projects Infrastructure (sub-category)
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$500,000/year (local staff time)
Potential Funding Sources:	Local; RSTP (Federal Roadway Funds); U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	Continuous action item Contingent upon funding availability
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 10	Develop improvements and continue enforcement of Zoning Ordinance/Town Code so that environmental hazards may minimize damage. During 2005/2006, the Town's zoning ordinance will be revised. This effort will be an opportunity to improve the Town's existing zoning regulations in order to keep development away from flood hazard areas, encourage cluster development, and underground utilities where feasible.
Category:	Prevention Land Use/Design/Codes (Sub-Category)
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Department of Community Development
Estimated Cost:	$100,000—professional consultant services (local staff time)
Potential Funding Sources:	Local; U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA)
Implementation Schedule:	2006—2007 Ongoing action item
Priority (High, Moderate, Low):	High

Town of Herndon Mitigation Action 11	Stormwater drainage improvements: Land acquisition, Design and construction in order to correct local area drainage problems and prevent flooding. Project areas include Monroe Street – Station Street; Madison Street – Grant Street to Dranesville Road; Park Avenue – Tyler Street to Grant Street. This initiative also includes outfall and stream restoration improvements to Runnymede / Sugarland Run.
Category:	Prevention Management Practices
Hazard(s) Addressed:	Multiple
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$1,420,000
Potential Funding Sources:	Local (identified in the Town's Capital Improvement Program)
Implementation Schedule:	Ongoing action item FY 2006–FY2010
Priority (High, Moderate, Low):	High

Town of Leesburg

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
High			
Moderate		✓	
Limited			

Town of Leesburg Mitigation Action 1	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
Category:	Public Works Projects
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	Engineering and Public Works, Office of Capital Projects, Planning, Town of Leesburg Police
Estimated Cost:	$2,043,531
Potential Funding Sources:	Coordinate with Virginia Department of Transportation (VDOT)
Implementation Schedule:	Undetermined at this point—based on funding availability
Priority (High, Moderate, Low):	High

Town of Leesburg Mitigation Action 2	Improve security measures as needed around critical facilities to include the Town's Emergency Operations Center (EOC). This should be coordinated with the Loudoun County Plan.
Category:	Emergency Facilities Protection
Hazard(s) Addressed:	All Hazards
Lead Agency/Department Responsible:	Town of Administration
Estimated Cost:	Unknown
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP); Buffer Zone Protection Program (BZPP)
Implementation Schedule:	Undetermined at this time—dependent on funding source and availability
Priority (High, Moderate, Low):	Moderate

Town of Leesburg Mitigation Action 3	Provide back-up power (generators, where needed) for critical facilities (i.e., fire stations, police stations, water facilities, etc.). This should be done in conjunction with the County Action Plan.
Category:	Community Facilities/Structural Protection
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	Police, Engineering and Public Works, Planning
Estimated Cost:	Unknown
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP); Buffer Zone Protection Program (BZPP)
Implementation Schedule:	Time schedule is dependent on funding source and availability
Priority (High, Moderate, Low):	Moderate

Town of Leesburg Mitigation Action 4	Provide for the rehabilitation of tree canopy coverage to improve run-off, soil preservation, recreation opportunities and aesthetics through the development of a Tree Management Program.
Category:	Community Facilities/Environmental Protection
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	Planning
Estimated Cost:	$50,000
Potential Funding Sources:	U.S. Department of Agriculture, Natural Resource Conservation Service: Emergency Watershed Protection
Implementation Schedule:	Time schedule is dependent on funding source and availability
Priority (High, Moderate, Low):	Low

Town of Purcellville

OVERALL CAPABILITY	HAZARD RISK: Low	Moderate	High
[redacted]		✓	
[redacted]			
Limited			

Town of Purcellville Mitigation Action 1	Replace and enlarge box culvert under East main Street west of Pickwick Drive to correct chronic flooding during heavy rain episodes. Expand roadway width to accommodate two lanes of moving traffic and a left turn lane for eastbound traffic to turn north onto Pickwick Drive. Remove silt build-up in channel leading to culvert.
Category:	Public Works Project
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	VDOT and Purcellville Street/Maintenance Dept.
Estimated Cost:	$1,000,000
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	Needs to be initiated immediately and placed on the 6 year VDOT plan.
Priority (High, Moderate, Low):	Highest

Town of Purcellville Mitigation Action 2	Provide emergency back-up power (generators) for critical facilities presently lacking such, specifically Town Hall, Well water pumps, and wastewater pumping facilities.
Category:	Public Works Project
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	Town Engineer and Public Works
Estimated Cost:	$7,500
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP); Buffer Zone Protection Program (BZPP)
Implementation Schedule:	Undetermined at this time, based on funding availability.
Priority (High, Moderate, Low):	High

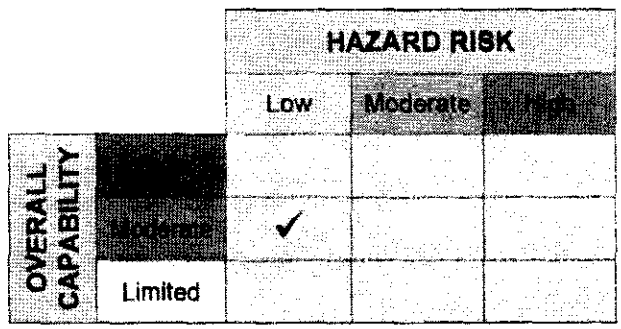
Town of Purcellville Mitigation Action 3	Enlarge box culvert and elevate roadway on Hirst Road at South Branch of Catoctin Creek. Chronic flooding conditions during periods of heavy rain and snow run-off.
Category:	Public Works Project
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	Street/Maintenance Department, Town Engineer , Town of Purcellville and VDOT
Estimated Cost:	$725,000
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	Undetermined at this time, based on funding availability.
Priority (High, Moderate, Low):	High

Town of Purcellville Mitigation Action 4	Drainage improvements and intersection reconfiguration. Replace and enlarge drainage culverts and re-design intersection to correct chronic flooding conditions and improve safety at intersection heavily traveled by school buses.
Category:	Public Works Project
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	Streets/Maintenance Department, Capital Projects, Town of Purcellville.
Estimated Cost:	$750,000
Potential Funding Sources:	U.S. Department of Homeland Security, Federal Emergency Management Agency: Flood Mitigation Assistance Program (FMA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant (PDM) Program
Implementation Schedule:	Based on funding availability, preferably within 5 year capital budget.
Priority (High, Moderate, Low):	High

Town of Purcellville Mitigation Action 5	Separate town communications band (frequency) into separate operating frequencies to eliminate conflict between police and public works transmissions. Frequent use of the radio for transmissions by Public works during emergency repair operations conflicts with police ability to transmit.
Category:	Public Works Project
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	Administration and Police
Estimated Cost:	$25,000
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	At the earliest opportunity.
Priority (High, Moderate, Low):	Moderate

Town of Purcellville Mitigation Action 6	Conduct all hazard community outreach program to provide emergency preparedness information regarding susceptible hazards and action steps when they occur. Program should be developed in several languages to ensure adequate coverage.
Category:	Public Information
Hazard(s) Addressed:	All Hazards Approach
Lead Agency/Department Responsible:	Emergency Management and Public Information
Estimated Cost:	Not known
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	Undetermined at this time, dependent on funding.
Priority (High, Moderate, Low):	Low

Town of Vienna



Town of Vienna Mitigation Action 1	Stream Siltation Study to reduce potential for flooding along Wolftrap Creek.
Category:	Natural Resource Protection
Hazard(s) Addressed:	Flooding
Lead Agency/Department Responsible:	Department of Public Works, Department of Planning and Zoning (Grant Applicant)
Estimated Cost:	$18,000
Potential Funding Sources:	Applied for VA Coastal Non-point Program Grant
Implementation Schedule:	As soon as funding allows
Priority (High, Moderate, Low):	High

Town of Vienna Mitigation Action 2	Develop Emergency Response Program for Town.
Category:	Prevention
Hazard(s) Addressed:	All
Lead Agency/Department Responsible:	Administration/Public Works
Estimated Cost:	$20,000
Potential Funding Sources:	Annual budgetary allocation for administration needs
Implementation Schedule:	Immediately
Priority (High, Moderate, Low):	High

Town of Vienna Mitigation Action 3	Develop Training Program for Emergency Responders.
Category:	Prevention/Education and Awareness
Hazard(s) Addressed:	All
Lead Agency/Department Responsible:	Administrative Services
Estimated Cost:	$10,000
Potential Funding Sources:	Annual budget
Implementation Schedule:	One to three years
Priority (High, Moderate, Low):	High

Town of Vienna Mitigation Action 4	Purchase and stock dedicated equipment (trailer or vehicle) for emergency response use.
Category:	Emergency Services
Hazard(s) Addressed:	All
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$10,000—$15,000
Potential Funding Sources:	Emergency Response Administrative Fund; U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	One to two years
Priority (High, Moderate, Low):	High

Town of Vienna Mitigation Action 5	Two portable generators/trailer (50KW); one permanent generator for Town Public Works facility (100KW)
Category:	Emergency Services
Hazard(s) Addressed:	All
Lead Agency/Department Responsible:	Department of Public Works
Estimated Cost:	$100,000
Potential Funding Sources:	Emergency Response Expenditures; U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP); Buffer Zone Protection Program (BZPP)
Implementation Schedule:	Immediately
Priority (High, Moderate, Low):	High

Town of Vienna Mitigation Action 6	Emergency equipment: flares and orange cones.
Category:	Emergency Services
Hazard(s) Addressed:	All
Lead Agency/Department Responsible:	Police
Estimated Cost:	$1,400
Potential Funding Sources:	Police annual budget
Implementation Schedule:	
Priority (High, Moderate, Low):	High

Town of Vienna Mitigation Action 7	Emergency Services Early Warning Notification—Reverse 911© System
Category:	Emergency Services
Hazard(s) Addressed:	All
Lead Agency/Department Responsible:	Police
Estimated Cost:	To Be Determined
Potential Funding Sources:	U.S. Department of Homeland Security, Office of Domestic Preparedness: Homeland Security Grant Program (HSGP)
Implementation Schedule:	As soon as funding allows
Priority (High, Moderate, Low):	High

PLAN MAINTENANCE PROCEDURES

This section discusses how the regional Mitigation Strategy will be implemented by NVRC and the region's participating local jurisdictions and how the overall Hazard Mitigation Plan will be evaluated and enhanced over time. 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
- Continued Public Involvement

44 CFR Requirement

44 CFR Part 201.6(c)(4)(i): The plan shall include a plan maintenance process that includes a section describing the method and schedule of monitoring, evaluating and updating the mitigation plan within a five-year cycle.

Implementation

Each jurisdiction participating in the Northern Virginia Regional 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 the monitoring and implementing the actions of other jurisdictions involved in the planning process.

44 CFR Requirement

44 CFR Part 201.6(c)(4)(ii): The plan maintenance process shall include a process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

In addition to the assignment of a local lead department or agency, an implementation time period or a specific implementation date has been assigned in order to assess whether actions are being implemented in a timely fashion. NVRC and its participating local jurisdictions will seek outside funding sources to implement mitigation projects in both the predisaster and post-disaster environments[1]. When applicable, potential funding sources have been identified and targeted for 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 Regional Hazard Mitigation Plan into other local planning documents, processes or mechanisms such as comprehensive or capital improvement plans, when appropriate[2]. The members of the Northern Virginia Hazard Mitigation Planning Committee 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 Regional Hazard Mitigation Plan, and will not contribute to increased hazard vulnerability in their particular jurisdictions or the region as a whole.

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[1] A listing of key federal hazard mitigation funding sources is provided in Appendix B.

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

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 Hazard Mitigation Planning Committee 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 Regional Hazard Mitigation Plan is deemed by the Northern Virginia Hazard Mitigation Planning Committee 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 jurisdictions individual Mitigation Action Plan that require specific planning and administrative tasks (e.g. plan amendments, ordinance revisions, capital improvement projects, etc.).

NVRC 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, NVRC will provide a copy of the Plan to the appropriate parties. NVRC will continue to recommend that all goals and strategies of new and updated local planning documents are consistent with the Regional Plan and will not contribute to increased hazards in the affected jurisdiction(s).

Monitoring, Evaluation and Enhancement

Periodic revisions and updates of the Regional 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 Hazard Mitigation Planning Committee 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 NVRC 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 NVRC and submitted to 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 wishes to no longer actively participate in the development and maintenance of the Regional Hazard Mitigation, they must notify the NVRC in writing.

Five (5) Year Plan Review

The Plan will be reviewed by the Northern Virginia Hazard Mitigation Planning Committee 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.

PLAN MAINTENANCE PROCEDURES

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. NVRC will be responsible for reconvening the Mitigation Planning Committee and conducting the five-year review in coordination with the Virginia Department of Emergency Management.

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 Regional Hazard Mitigation Plan will be submitted to the State Hazard Mitigation Officer for final review and approval in coordination with the Federal Emergency Management Agency.

Disaster Declaration

Following a disaster declaration, the Northern Virginia Hazard Mitigation Planning Committee 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 NVRC to reconvene the Hazard Mitigation Planning Committee and to ensure the appropriate stakeholders are invited to participate in the plan revision and update process following declared disaster events.

Reporting Procedures

The results of the five-year review will be summarized by the Northern Virginia Hazard Mitigation Planning Committee 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 the completion of the task.

Plan Amendment Process

Local participating jurisdictions have the authority to approve/adopt changes to their own Mitigation Action Plans without approval from NVRC; however, NVRC should be advised of all changes as a courtesy and for consideration for changes or modifications to the regional Plan. NVRC 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.

NVRC 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 Northern Virginia Hazard Mitigation Planning Committee 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 Northern Virginia Hazard Mitigation Planning Committee:

- 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.
- There has been a change in local capabilities to implement proposed hazard mitigation activities.

Upon receiving the recommendation from the Northern Virginia Hazard Mitigation Planning Committee 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;

Plan Amendment Process

Local participating jurisdictions have the authority to approve/adopt changes to their own Mitigation Action Plans without approval from NVRC; however, NVRC should be advised of all changes as a courtesy and for consideration for changes or modifications to the regional Plan. NVRC 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.

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At the end of the 45-day review and comment period, the proposed amendment(s) and all comments will be forwarded to the Northern Virginia Hazard Mitigation Planning Committee 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 Northern Virginia Hazard Mitigation Planning Committee:

- 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.
- There has been a change in local capabilities to implement proposed hazard mitigation activities.

Upon receiving the recommendation from the Northern Virginia Hazard Mitigation Planning Committee 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 Northern Virginia Hazard Mitigation Planning Committee for further revision; or
- Defer the amendment request back to the Northern Virginia Hazard Mitigation Planning Committee for further consideration and/or additional hearings.

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.

44 CFR Requirement

44 CFR Part 201.6(c)(4)(iii): The plan maintenance process shall include a discussion on how the community will continue public participation in the plan maintenance process.

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 Northern Virginia Hazard Mitigation Planning Committee in the local newspaper, public bulletin boards and/or municipal or county office buildings;
- Designating willing and voluntary citizens and private sector representatives as official members of the Northern Virginia Hazard Mitigation Planning Committee;
- Utilizing local media to update the public of any maintenance and/or periodic review activities taking place;
- Utilizing NVRC as well as municipal or county Web sites 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 Web sites.

APPENDIX A:
PLAN ADOPTION

This section of the Plan includes copies of the local resolutions adopted by each of the Northern Virginia region's local jurisdictions requesting approval of the Plan.

44 CFR Requirement

44 CFR Part 201.6(c)(5): *The plan shall include documentation that the plan has been formally adopted by the local governing body of the jurisdiction requesting approval of the plan. For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.*

Editorial Note: Local resolutions will be inserted here

APPENDIX B:
KEY FEDERAL HAZARD MITIGATION FUNDING PROGRAMS

This section of the Plan includes a listing of some of the key, well-established federal hazard mitigation funding programs available to implement future mitigation projects. Additional sources of mitigation funding are routinely made available through a variety state and federal agencies though the program names, funding amounts and eligibility criteria will vary over time.

KEY FEDERAL HAZARD MITIGATION FUNDING PROGRAMS

Grant Name	Agency	Purpose	Contact
Pre-Disaster Mitigation Program (PDM)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To provide funding for States and communities for cost-effective hazard mitigation activities which complement a comprehensive hazard mitigation program and reduce injuries, loss of life, and damage and destruction of property.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Hazard Mitigation Grant Program (HMGP)	U.S. Department of Homeland Security, Federal Emergency Management Agency	Provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster declaration.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Flood Mitigation Assistance Program (FMA)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To help States and communities plan and carry out activities designed to reduce the risk of flood damage to structures insurable under the NFIP.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Homeland Security Grant Program (HSGP)	U.S. Department of Homeland Security, Office of Domestic Preparedness	To enhance the ability of states, territories, urban areas, and local agencies to prevent, deter, respond to, and recover from threats and incidents of terrorism. The HSGP integrates the State Homeland Security Program (SHSP), the Urban Areas Security Initiative (UASI), the Law Enforcement Terrorism Prevention Program (LETPP), the Citizen Corps Program (CCP), the Emergency Management Performance Grants (EMPG), and the Metropolitan Medical Response System (MMRS) Program Grants into a single funding program.	ODP 810 Seventh Street, N.W. Washington, DC 20531 Phone: (800) 368-6498 www.ojp.usdoj.gov/odp/

Grant Name	Agency	Purpose	Contact
Buffer Zone Protection Program (BZPP)	U.S. Department of Homeland Security, Office of Domestic Preparedness	To provide funding for the equipment, management, and administration of actions, to protect, secure, and reduce the vulnerabilities of identified critical infrastructure and key resource (CI/KR) sites.	ODP 810 Seventh Street, N.W. Washington, DC 20531 Phone: (800) 368-6498 www.ojp.usdoj.gov/odp/
Transit Security Grant Program (TSGP)	U.S. Department of Homeland Security, Office of Domestic Preparedness	To provide funding for security and preparedness enhancements for designated transit systems. Funding is allowed for planning, organizational activities, equipment acquisitions, training, exercises, and management and administrative costs	ODP 810 Seventh Street, N.W. Washington, DC 20531 Phone: (800) 368-6498 www.ojp.usdoj.gov/odp/
Public Assistance Program (PA)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To provide supplemental assistance to States, local governments, and certain private nonprofit organizations to alleviate suffering and hardship resulting from major disasters or emergencies declared by the President. Under Section 406, Public Assistance funds may be used to mitigate the impact of future disasters.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Flood Control Works / Emergency Rehabilitation	U.S. Department of Defense, Army Corps of Engineers	To assist in the repair and restoration of public works damaged by flood, extraordinary wind, wave, or water action.	USACE 20 Massachusetts Avenue, N.W. Washington, DC 20314 Phone: (202) 761-0001 www.usace.army.mil
Community Development Grant Program (CDBG)	U.S. Department of Housing and Urban Development	To develop viable urban communities by providing decent housing, a suitable living environment, expanding economic opportunities or meeting other community development needs having a particular urgency because existing conditions pose a serious and immediate threat to the health or welfare of the community where other financial resources are not available. Principally for persons of low and moderate income.	HUD 451 7th Street, S.W. Washington, DC 20410-7000 Phone: (202) 708-3587 www.hud.gov

Grant Name	Agency	Purpose	Contact
Emergency Watershed Protection	U.S. Department of Agriculture, Natural Resource Conservation Service	To provide emergency technical and financial assistance to install or repair structures that reduces runoff and prevents soil erosion to safeguard life and property.	NRCS PO Box 2890 Washington, DC 20013 Phone: (202) 720-3527 www.nrcs.usda.gov
Watershed Protection and Flood Prevention	U.S. Department of Agriculture, Natural Resource Conservation Service	To provide technical and financial assistance in planning and executing works of improvement to protect, develop, and use land and water resources in small watersheds.	NRCS PO Box 2890 Washington, DC 20013 Phone: (202) 720-3527 www.nrcs.usda.gov
Land and Water Conservation Fund Grants	U.S. Department of the Interior, National Park Service	To acquire and develop outdoor recreation areas and facilities for the general public, to meet current and future needs.	NPS PO Box 37127 Washington, DC 20013-7127 Phone: (202) 565-1200 www.nps.gov
Disaster Mitigation and Technical Assistance Grants	U.S. Department of Commerce, Economic Development Administration	To help States and localities to develop and/or implement a variety of disaster mitigation strategies.	EDA Herbert C. Hoover Building Washington DC, 20230 Phone: (800) 345-1222 www.eda.gov
Pre-Disaster Mitigation Loan Program	U.S. Small Business Administration	To make low-interest; fixed-rate loans to eligible small businesses for the purpose of implementing mitigation measures to protect business property from damage that may be caused by future disasters.	SBA 1110 Vermont Avenue, N.W., 9th Floor Washington, DC 20005 Phone: (202) 606-4000 www.sba.gov
Watershed Surveys and Planning	U.S. Department of Agriculture, Natural Resource Conservation Service	To provide planning assistance to Federal, State, and local agencies for the development of coordinated water and related land resources programs in watersheds and river basins.	NRCS PO Box 2890 Washington, DC 20013 Phone: (202) 720-3527 www.nrcs.usda.gov

Grant Name	Agency	Purpose	Contact
National Earthquake Hazards Reduction Program (NEHRP)	U.S. Department of Homeland Security, Federal Emergency Management Agency	To mitigate earthquake losses that can occur in many parts of the nation providing earth science data and assessments essential for warning of imminent damaging earthquakes, land-use planning, engineering design, and emergency preparedness decisions.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Assistance to Firefighters Grant Program	U.S. Department of Homeland Security, Federal Emergency Management Agency, U.S. Fire Administration	Competitively awarded project grants to provide direct assistance, on a competitive basis, to fire departments for the purpose of protecting the health and safety of the public and firefighting personnel against fire and fire-related hazards.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Fire Management Assistance Grants	U.S. Department of Homeland Security, Federal Emergency Management Agency, U.S. Fire Administration	To provide project grants and the provision of specialized services for the mitigation, management, and control of fires that threatens such destruction as would constitute a major disaster.	FEMA 500 C Street, S.W. Washington, DC 20472 Phone: (202) 646-4621 www.fema.gov
Emergency Streambank and Shoreline Protection	U.S. Department of Defense, Army Corps of Engineers	To prevent erosion damages to public facilities by the emergency construction or repair of streambank and shoreline protection works.	USACE 20 Massachusetts Avenue, N.W. Washington, DC 20314 Phone: (202) 761-0001 www.usace.army.mil
Small Flood Control Projects	U.S. Department of Defense, Army Corps of Engineers	To reduce flood damages through small flood control projects not specifically authorized by Congress.	USACE 20 Massachusetts Avenue, N.W. Washington, DC 20314 Phone: (202) 761-0001 www.usace.army.mil
Clean Water Act Section 319 Grants	U.S. Environmental Protection Agency	To implement non-point source programs, including support for non-structural watershed resource restoration activities.	EPA Ariel Rios Building 1200 Pennsylvania Avenue, N.W. Washington, DC 20460 Phone: (202) 272-0167 www.epa.gov

APPENDIX C:
LOCAL MITIGATION PLAN CROSSWALK

This section of the Plan includes a completed copy of the Local Mitigation Plan Crosswalk.

Local Mitigation Plan Review and Approval Status

Jurisdiction: Northern Virginia Region	**Title of Plan:** Regional Hazard Mitigation Plan	**Date of Plan:** July 2005
Local Point of Contact: James Van Zee	**Address:**	
Title: Director, Regional Planning Services	Williams Plaza 2 3060 Williams Drive, 5th Floor Fairfax, VA 22031	
Agency: Northern Virginia Regional Commission		
Phone Number: (703) 642-4630	**E-Mail:** jvanzee@novaregion.org	

State Reviewer:	**Title:**	**Date:**

FEMA Requirement:		
Contractor Reviewer:	**Title:**	**Date:**
Contractor QA/QC:	**Title:**	**Date:**
FEMA Reviewer:	**Title:**	**Date:**
FEMA QA/QC:	**Title:**	**Date:**
Date Received in FEMA Region III		
Plan Not Approved		
Plan Approved		
Date Approved		

Jurisdiction:	NFIP Status*			
	Y	N	N/A	CRS Class
1. Arlington County	✓			9
2. Fairfax County	✓			8
3. Loudoun County	✓			10
4. Prince William County	✓			8
5. Alexandria	✓			8
6. Fairfax	✓			N/A
7. Falls Church	✓			N/A
8. Manassas	✓			N/A
9. Manassas Park	✓			N/A
10. Dumfries	✓			N/A
11. Herndon	✓			N/A
12. Leesburg	✓			N/A
13. Purcellville	✓			N/A
14. Vienna	✓			9
15. Northern Virginia Regional Commission	N/A	N/A	N/A	N/A

*** Notes:** **Y = Participating** **N = Not Participating** **N/A = Not Mapped**

LOCAL MITIGATION PLAN REVIEW SUMMARY

The plan cannot be approved if the plan has not been formally adopted.

Each requirement includes separate elements. All elements of the requirement must be rated "Satisfactory" in order for the requirement to be fulfilled and receive a score of "Satisfactory." Elements of each requirement are listed on the following pages of the Plan Review Crosswalk. A "Needs Improvement" score on elements shaded in gray (recommended but not required) will not preclude the plan from passing. Reviewer's comments must be provided for requirements receiving a **"Needs Improvement"** score.

SCORING SYSTEM

Please check one of the following for each requirement.

N – Needs Improvement: The plan does not meet the minimum for the requirement. Reviewer's comments must be provided.

S – Satisfactory: The plan meets the minimum for the requirement. Reviewer's comments are encouraged, but not required.

Prerequisite(s) (Check Applicable Box)	**NOT MET**	**MET**
Adoption by the Local Governing Body: §201.6(c)(5) **OR**		
Multi-Jurisdictional Plan Adoption: §201.6(c)(5) **AND** Multi-Jurisdictional Planning Participation: §201.6(a)(3)		

Planning Process	**N**	**S**
Documentation of the Planning Process: §201.6(b) and §201.6(c)(1)		

Risk Assessment	**N**	**S**
Identifying Hazards: §201.6(c)(2)(i)		
Profiling Hazards: §201.6(c)(2)(i)		
Assessing Vulnerability: Overview: §201.6(c)(2)(ii)		
Assessing Vulnerability: Identifying Structures: §201.6(c)(2)(ii)(A)		
Assessing Vulnerability: Estimating Potential Losses: §201.6(c)(2)(ii)(B)		
Assessing Vulnerability: Analyzing Development Trends: §201.6(c)(2)(ii)(C)		
Multi-Jurisdictional Risk Assessment: §201.6(c)(2)(iii)		

Mitigation Strategy	**N**	**S**
Local Hazard Mitigation Goals: §201.6(c)(3)(i)		
Identification and Analysis of Mitigation Actions: §201.6(c)(3)(ii)		
Implementation of Mitigation Actions: §201.6(c)(3)(iii)		
Multi-Jurisdictional Mitigation Actions: §201.6(c)(3)(iv)		

Plan Maintenance Process	**N**	**S**
Monitoring, Evaluating, and Updating the Plan: §201.6(c)(4)(i)		
Incorporation into Existing Planning Mechanisms: §201.6(c)(4)(ii)		
Continued Public Involvement: §201.6(c)(4)(iii)		

Additional State Requirements*	**N**	**S**
Insert State Requirement		
Insert State Requirement		
Insert State Requirement		

LOCAL MITIGATION PLAN APPROVAL STATUS

PLAN NOT APPROVED ☐

PLAN APPROVED ☐

*States that have additional requirements can add them in the appropriate sections of the *Multi-Hazard Mitigation Planning Guidance* or create a new section and modify this Plan Review Crosswalk to record the score for those requirements.

See Reviewer's Comments

PREREQUISITE(S)

Adoption by the Local Governing Body

Requirement §201.6I(5): *[The local hazard mitigation plan **shall** include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE NOT MET	SCORE MET
A. Has the local governing body adopted the plan?	The plan will be adopted once VDEM and FEMA approval is granted.			
B. Is supporting documentation, such as a resolution, included?	Adoption resolutions will be included after adoption upon FEMA approval.			
		SUMMARY SCORE		

Multi-Jurisdictional Plan Adoption

Requirement §201.6I(5): *For multi-jurisdictional plans, each jurisdiction requesting approval of the plan **must** document that it has been formally adopted.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE NOT MET	SCORE MET
A. Does the plan indicate the specific jurisdictions represented in the plan?	Section 1, pages 3-4			
B. For each jurisdiction, has the local governing body adopted the plan?	Each jurisdiction will adopt the plan after FEMA has granted approval.			
C. Is supporting documentation, such as a resolution, included for each participating jurisdiction?	Each jurisdiction will supply adoption resolutions after			

	FEMA has granted approval of the plan.			
		SUMMARY SCORE		

Multi-Jurisdictional Planning Participation

Requirement §201.6(a)(3): *Multi-jurisdictional plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process ... Statewide plans will not be accepted as multi-jurisdictional plans.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE NOT MET	SCORE MET
A. Does the plan describe **how** each jurisdiction participated in the plan's development?	Section 2, throughout, and specifically on pages 14-15.			
		SUMMARY SCORE		

PLANNING PROCESS: *§201.6(b): An open public involvement process is essential to the development of an effective plan.*

Documentation of the Planning Process

Requirement §201.6(b): *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process **shall** include:*
(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring jurisdictions, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.6I(1): *[The plan **shall** document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
C. Does the plan provide a narrative description of the process followed to prepare the plan?	Section 2, throughout.			
B. Does the plan indicate who was involved in the planning process? (For example, who led the development at the staff level and were there any	Section 2, pages 3-5.			

external contributors such as contractors? Who participated on the plan committee, provided information, reviewed drafts, etc.?)				
C. Does the plan indicate how the public was involved? (Was the public provided an opportunity to comment on the plan during the drafting stage and prior to the plan approval?)	Section 2, pages 13-14.			
D. Was there an opportunity for neighboring jurisdictions, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?	Section 2, pages 13-15.			
E. Does the planning process describe the review and incorporation, if appropriate, of existing plans, studies, reports, and technical information?	Section 7, throughout.			
		SUMMARY SCORE		

RISK ASSESSMENT: *§201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.*

Identifying Hazards

Requirement §201.6(c)(2)(i): *[The risk assessment **shall** include a] description of the type ... of all natural hazards that can affect the jurisdiction.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan include **a description** of the types of **all natural hazards** that affect the jurisdiction?	Section 4 throughout.			
		SUMMARY SCORE		

Profiling Hazards

Requirement §201.6(c)(2)(i): *[The risk assessment **shall** include a] description of the ... location and extent of all natural hazards that can affect the jurisdiction. The plan **shall** include information on previous occurrences of hazard events and on the probability of future hazard events.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S

A. Does the risk assessment identify the **location** (i.e., geographic area affected) of each natural hazard addressed in the plan?	Section 5 throughout.			
B. Does the risk assessment identify the **extent** (i.e., magnitude or severity) of each hazard addressed in the plan?	Section 5 throughout.			
C. Does the plan provide information on **previous occurrences** of each hazard addressed in the plan?	Section 5, throughout.			
D. Does the plan include the **probability of future events** (i.e., chance of occurrence) for each hazard addressed in the plan?	Sections 4-6, specifically Section 5.			
		SUMMARY SCORE		

Assessing Vulnerability: Overview

Requirement §201.6(c)(2)(ii): *[The risk assessment **shall** include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description **shall** include an overall summary of each hazard and its impact on the community.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan include an **overall summary** description of the jurisdiction's **vulnerability** to each hazard?	Section 6, throughout.			
B. Does the plan address the **impact** of each hazard on the jurisdiction?	Section 6, throughout.			
		SUMMARY SCORE		

Assessing Vulnerability: Identifying Structures

Requirement §201.6(c)(2)(ii)(A): *The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area ... .*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan describe vulnerability in terms of the **types and numbers** of **existing** buildings, infrastructure, and critical facilities located in the identified hazard areas?	Section 6, throughout.			
B. Does the plan describe vulnerability in terms of the **types and numbers** of **future** buildings, infrastructure, and critical facilities located in the identified hazard				

areas?				
		SUMMARY SCORE		

Assessing Vulnerability: Estimating Potential Losses

Requirement §201.6(c)(2)(ii)(B): *[The plan **should** describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate … .*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan estimate **potential dollar losses to vulnerable structures?**	Section 6, throughout.			
B. Does the plan describe **the methodology** used to prepare the estimate?	Section 6, pages 1-5.			
		SUMMARY SCORE		

Assessing Vulnerability: Analyzing Development Trends

Requirement §201.6(c)(2)(ii)(C): *[The plan **should** describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan describe land uses and development trends?	Sections 3 and 6			
		SUMMARY SCORE		

Multi-Jurisdictional Risk Assessment

Requirement §201.6(c)(2)(iii): *For multi-jurisdictional plans, the risk assessment **must** assess each jurisdiction's risks where they vary from the risks facing the entire planning area.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan include a risk assessment for each participating jurisdiction as needed to reflect unique or varied risks?	Sections 5-6			
		SUMMARY SCORE		

MITIGATION STRATEGY: *§201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.*

Local Hazard Mitigation Goals

Requirement §201.6(c)(3)(i): *[The hazard mitigation strategy **shall** include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A Does the plan include a description of mitigation **goals** to reduce or avoid long-term vulnerabilities to the identified hazards? (**GOALS** are long-term; represent what the community wants to achieve, such as "eliminate flood damage"; and are based on the risk assessment findings.)	Section 8, pages 2-3.			
		SUMMARY SCORE		

Identification and Analysis of Mitigation Actions

Requirement §201.6(c)(3)(ii): *[The mitigation strategy **shall** include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan identify and analyze a **comprehensive range** of specific mitigation actions and projects for each hazard?	Section 8, pages 3-6 and Section 9, throughout.			
B Do the identified actions and projects address reducing the effects of hazards on **new** buildings and infrastructure?	Section 9, throughout.			
C. Do the identified actions and projects address reducing the effects of hazards on **existing** buildings and infrastructure?	Section 9, throughout.			
		SUMMARY SCORE		

Implementation of Mitigation Actions

Requirement: §201.6(c)(3)(iii): *[The mitigation strategy section **shall** include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization **shall** include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the mitigation strategy include how the actions are **prioritized**? (For example, is there a discussion of the process and criteria used?)	Section 2, page 13 (footnote); Section 8, pages 2 and 7.			
B. Does the mitigation strategy address how the actions will be **implemented and administered**? (For example, does it identify the responsible department, existing and potential resources, and timeframe?)	Section 9, throughout. Section 10, page 1-2.			
C. Does the prioritization process include an emphasis on the use of a **cost-benefit review** (see page 3-36 of *Multi-Hazard Mitigation Planning Guidance*) to maximize benefits?	Section 2, page 13 (footnote); Section 8, pages 2 and 7.			
		SUMMARY SCORE		

Multi-Jurisdictional Mitigation Actions

Requirement §201.6(c)(3)(iv): *For multi-jurisdictional plans, there **must** be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A Does the plan include at least one identifiable **action item** for each jurisdiction requesting FEMA approval of the plan?	Section 9, throughout.			
		SUMMARY SCORE		

PLAN MAINTENANCE PROCESS

Monitoring, Evaluating, and Updating the Plan

Requirement §201.6(c)(4)(i): *[The plan maintenance process* ***shall*** *include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan describe the method and schedule for **monitoring** the plan? (For example, does it identify the party responsible for monitoring and include a schedule for reports, site visits, phone calls, and meetings?)	Section 10, pages 2-3			
B. Does the plan describe the method and schedule for **evaluating** the plan? (For example, does it identify the party responsible for evaluating the plan and include the criteria used to evaluate the plan?)	Section 10, pages 2-3			
C. Does the plan describe the method and schedule for **updating** the plan within the five-year cycle?	Section 10, pages 2-4			
		SUMMARY SCORE		

Incorporation into Existing Planning Mechanisms

Requirement §201.6(c)(4)(ii): *[The plan* ***shall*** *include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan identify other local planning mechanisms available for incorporating the requirements of the mitigation plan?	Sections 7, throughout. Section 10, pages 1-2			

B. Does the plan include a process by which the local government will incorporate the requirements in other plans, when appropriate?	Section 10, pages 1-2.			
		SUMMARY SCORE		

Continued Public Involvement

Requirement §201.6(c)(4)(iii): *[The plan maintenance process **shall** include a] discussion on how the community will continue public participation in the plan maintenance process.*

Element	**Location in the Plan** (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan explain how **continued public participation** will be obtained? (For example, will there be public notices, an on-going mitigation plan committee, or annual review meetings with stakeholders?)	Section 10, page 5.			
		SUMMARY SCORE		

RESOLUTION NO. 2217

WHEREAS, the Disaster Mitigation Act of 2000, as amended, requires that local governments develop and adopt natural hazard mitigation plans in order to be eligible for funding under the Pre-Disaster and Hazard Mitigation Grant Programs; and

WHEREAS, the Virginia Department of Emergency Management (VDEM) awarded a grant to the Northern Virginia Regional Commission (NVRC) in 2004 to develop a comprehensive Regional Hazard Mitigation Plan for Northern Virginia; and

WHEREAS, NVRC has coordinated this planning in collaboration with the Northern Virginia Hazard Mitigation Planning Committee (which includes representatives from local planning and emergency management staffs as well as VDEM) and with professional assistance from the consulting firm Post, Buckley, Schuh & Jernigan; and

WHEREAS, the plan outlines actions designed to address and reduce the impact of a full range of natural hazards facing the region, ranging from hazards as floods, tornadoes, hurricanes, earthquakes, wildfires and drought; and

WHEREAS, VDEM and the Federal Emergency Management Agency (FEMA) have approved the Northern Virginia Regional Hazard Mitigation Plan, pending approval by each local governing body.

NOW, THEREFORE BE IT RESOLVED by the City Council of the City of Alexandria that the Northern Virginia Regional Hazard Mitigation Plan dated March 2006, is hereby approved and adopted as amended for the City of Alexandria;

BE IT FURTHER RESOLVED that Alexandria City Council calls on emergency management to work with NVRC and VDEM to assure continued compliance with the Disaster Mitigation Act of 2000 and such additional regulations and/or certifications that may be identified to guarantee local and regional preparedness for all potential hazards and disasters.

ADOPTED: February 15, 2007

WILLIAM D. EUILLE MAYOR

ATTEST:

Jacqueline M. Henderson, CMC City Clerk