MIDDLE PENINSULA NATURAL HAZARDS MITIGATION PLAN

Prepared by the Middle Peninsula Planning District Commission's
Natural Hazard Mitigation Program
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1. Introduction

The Disaster Mitigation Act of 2000 (DMA 2K), approved by Congress and signed into law in October 2000 (Public Law 106-390), is a key component of the Federal government's commitment to reduce damages to private and public property through mitigation. This legislation established the Pre-Disaster Mitigation Program (PDM) and new requirements for the Post-Disaster Hazard Mitigation Grant Program (HGMP).

DMA 2K requires local governments to develop and submit mitigation plans to qualify for PDM and HMGP funds. The Act requires that the Plan demonstrate "a jurisdiction's commitment to reduce risk from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards." The final Plan must be adopted by each participating jurisdiction and approved by the Virginia Department of Emergency Management (VDEM) and the Federal Emergency Management Agency (FEMA).

Middle Peninsula localities elected to group together to develop a regional plan. The Middle Peninsula Regional Natural Hazard Mitigation Plan is a multi-jurisdictional plan that represents the six counties and three towns of the Middle Peninsula. The Plan identifies goals for hazard mitigation and risk reduction to make the community more disaster resistant and contribute to the region's long-term sustainability. The Plan not only addresses current concerns, but can also be used to help guide and coordinate mitigation activities and local policy decisions for future land use.

The Middle Peninsula Planning District Commission guided the development of the Regional Natural Hazard Mitigation Plan according to the requirements of DMA 2K. Hazard Mitigation is defined as any sustained action taken to reduce or eliminate long-term risk to human life or property from hazards. The development of this Plan involved establishing goals, developing strategy, and outlining tasks and schedules to accomplish these goals. The Middle Peninsula localities identified natural hazards that threaten the region, determined the likely impact of those hazards, assessed the region's vulnerability to and capability to address those hazards, set mitigation goals, and determined and prioritized appropriate strategies that would lessen the potential impacts of the hazards.

This Plan follows DMA 2K planning requirements and associated guidance documents for developing Local Hazard Mitigation Plans. The guidance sets forth a four-step mitigation planning process: 1) organize resources, 2) assess hazards and risks, 3) develop a mitigation plan, and 4) evaluate the Plan. The Plan also utilizes the process outlined in FEMA's Crosswalk Reference Document for Review and Submission of Local Mitigation Plans.

2. Community Profile: A Description of the Middle Peninsula of Virginia

The Middle Peninsula is located on the western shore of Chesapeake Bay, bounded to the north by the Rappahannock River and to the south by the York River. It encompasses the counties of Essex, Gloucester, King and Queen, King William, Mathews, and Middlesex, and the towns of Tappahannock, Urbanna, and West Point.

The region is known for its many waterways – broad rivers, meandering creeks, wide bays, and tidal marshes – which contribute to its susceptibility to floods and coastal storms. The Middle Peninsula is rural and historic, with closely-knit, small communities surrounded by working farms and forests. The region's abundant natural resources form the base of its traditional fishery, farm and forest industries, and well as growing sectors in tourism and retiree services.

While the Middle Peninsula remains largely rural, it lies in close proximity to the metropolitan areas of Hampton Roads, Richmond, and Fredericksburg-Northern Virginia. Suburban growth from these urban areas is spreading into the Middle Peninsula, affecting the region's resource-based industries and traditional rural lifestyle.

The sections that follow briefly explain the geographic settings and population trends of each of the Counties and Towns of the Middle Peninsula based on information contained within their respective Comprehensive Plans.

2.1. Essex County

Essex County is predominantly a rural county on the north end of the Middle Peninsula. It is bounded on the north by King George and Westmoreland Counties, on the east by Richmond County, south by Middlesex County, and by Caroline and King and Queen Counties on the west. The Rappahannock River runs along the northeast boundary of the County. The County comprises approximately 261 square miles (Essex County Comprehensive Plan, 2003).

The Town of Tappahannock is both the employment and population center for the County. Other residential developments exist as small rural communities along the Rappahannock River or as strip residential along the primary roadways. Throughout most of the County's past, growth has been gradual and slow and the County has remained mostly rural.

The 2000 Census shows the Essex population to be 9,989, an increase of 1,300 (15%) over the 1990 census. The County believes the 1990 Census undercounted the population at the time and that true population growth has been steady and at a low to moderate rate over the last 20 years. Population also aged somewhat during this period, with a modest reduction in school age

population. These trends suggest that County programs may at some point require redirection in meeting the special needs (health care, transportation) of an older population. Population is not rapidly growing in Essex County and low to moderate trend in growth is expected to continue (Essex County Comprehensive Plan, 2003).

2.2. Town of Tappahannock

Tappahannock is an incorporated town located on the shores of the Rappahannock River in the eastern portion of Essex County. Occupying less than three square miles of land, Tappahannock features an active waterfront, a historic downtown, residential subdivisions, schools and other public facilities, an airport and industrial center, a business corridor, and extensive wetland areas. Tappahannock serves as the county seat for Essex County.

The 2000 population in Tappahannock was 2,055, an increase of 345 persons (20.2%) over the 1990 total of 1,710. Population forecasts indicate that by 2010, there will be approximately 2,567 residents in the Town (Town of Tappahannock Comprehensive Plan 1998). Tappahannock is aware that this potential growth of the Town underscores the need for attention to growth management. The form, pattern, and distribution of new development needed to accommodate for this growth in population, together with the qualities of commercial and industrial development to meet the residents' shopping and employment needs, will influence a number of factors that will strongly influence the future of the quality of life for the Town.

2.3. Gloucester County

Gloucester County is located in the southeastern portion of Virginia's Middle Peninsula. The county is bounded on the south by the York River, the north by the Piankatank River and the east by Mobjack Bay. Gloucester County's industries have traditionally been associated with the abundant natural resources found in the area. With its advantageous location in the geographic center of the Eastern Seaboard, the county has experienced an increased diversification in manufacturing activities.

Gloucester County is one of the fastest growing counties in the State, demonstrating an annual growth of 6.4% in the 1980's. It is the most populous county of the Middle Peninsula with a 2000 population of 34,780 persons. The County's proximity to urban centers to the south and the westward migration of suburban development from the greater Hampton Roads/Newport News area has transformed portions of the County to a suburban development pattern which is most pronounced at the southern reaches of the County. Metropolitan residents to the south are lured to the County by the promise of lower taxes, lower housing costs, rural character, and relative freedom from the congestion evident in the counties nearer to Newport News/Hampton Roads. This has

created increased traffic volumes on highways not designed for such heavy use. Gloucester County has established a “Growth Management Philosophy” outlined as a “contained growth” strategy in the County’s Comprehensive Plan to manage the future form, pattern, quantities, and distribution of growth in Gloucester County.

2.4. King and Queen

King and Queen County is located in the northeastern part of the Middle Peninsula and is bounded on the southwest by the York and Mattaponi Rivers which separate King and Queen from King William and New Kent Counties. The Dragon Swamp separates King and Queen from Caroline, Essex, Middlesex and Gloucester Counties. Often called the "shoestring county" King and Queen is about 65 miles long and less than 10 miles wide.

King and Queen County is the least populous county of the Middle Peninsula and one of the most rural counties in Virginia today. In 1990, the population density was only 20 persons per square mile. Nearly three-fourths of the County’s 318.1 square miles of land area is timberland. Over the past three decades, King and Queen County has experiences slow but steady growth. Between 1970 and 1980, the population increased 8.7% to 5,968; between 1980 and 1990, the population increased 5.4% to 6,289. In 2000, the population of King and Queen County rose to 6,630. The overall population distribution appears to be experiencing a gradual shift to the upper and lower ends of the County where transportation routes to job and trade markets are most favorable.

2.5. King William County

Located approximately 20 miles northeast of Richmond, King William County is growing quickly as a bedroom community to the metro-Richmond area. Much of the County’s 286 square miles are made up of gently rolling farmland and scenic timberland between the Pamunkey and Mattaponi Rivers. Farming and logging continue as mainstays of the local economy. King William is home to the only Native American Indian reservations in the Commonwealth and to the oldest courthouse in continuous use in the United States. The Mattaponi and Pamunkey tribes operate hatcheries on the rivers, and residents and visitors enjoy the numerous recreational opportunities the rivers provide.

The 2000 population in King William County was 13,146, an increase of 2,233 persons (20.5%) over the 1990 total of 10,913. Over the last 30 years, the County’s population has steadily increased from 7,497 in 1970 and 9, 334 in 1980 (King William County Comprehensive Plan, 2003). The Virginia Employment Commission projections indicate that King William County will continue to experience accelerated population growth. By the year 2010, it is estimated that the County’s population will grow by 2,857 persons, or 21.7%.

Growth management will become more problematic as competing uses vie for space and facilities.

2.6. Town of West Point

The Town of West Point lies at the extreme southern end of King William County where the Mattaponi and Pamunkey Rivers join to form the York River. The Rivers are tidal, having an approximate tidal range of three feet. The river areas surrounding West Point are primarily used for recreation and barge access for the Smurfit-Stone Containerboard Mill (where pulping operations convert wood chips, sawdust and recyclable paper products into pulp for use in producing various types of paperboard) and Old Dominion Grain Corporation.

The Town is relatively flat, with large sections of the Town, particularly on the Mattaponi River, comprised of tidal marshes. The highest elevations occur in the northern part of the Town at a height of 30+ feet. Most of the Pamunkey River waterfront is on a bluff averaging 20 feet.

Union forces destroyed the Town and the railroad that was completed in 1859 during the Civil War and only four houses that survived the torching remain intact today. West Point became an incorporated town in 1870. During the late 19th and early 20th centuries, was a popular tourist destination. After the decline of tourism, a shipyard, built in 1917, and a pulp mill, built in 1918, revitalized the Town.

The population of West Point in 2000 was 2,906, a decrease of 32 persons (1%) below the 1990 census population of 2,938. Between 1960 and 1990, the Town's population steadily increased from 1,678 (1960 Census), to 2,600 in 1970, 2,726 in 1980, and 2,938 in 1990 (West Point Comprehensive Plan, 2000).

2.7. Mathews County

Mathews County is located at the eastern tip of the Middle Peninsula. The County is bordered mostly by water, with the Chesapeake Bay to the east, Mobjack Bay on the south, the North River on the west, and the Piankatank River on the north. Except for approximately five miles that borders Gloucester County, the County's perimeter is formed entirely by its 217 mile shoreline. Mathews is predominantly a rural community that has attracted an increasing number or retirees and vacationers. More than half the working residents earn their livings outside the County while other local businesses are based on agriculture, trade, seafood, and tourism.

Mathews County's population changed little between 1840 and 1900. The population peaked in 1910 with 8,922 residents, but gradually declined over the next five decades to a low point of 7,121 in 1960. This was in keeping with a national trend of population shifts from rural to urban areas because of increased

job opportunities there; Mathews lost population to urban areas for more than half of the 20th century. The population began to grow in the 1970's and it took until the mid 1990's before the population again reached the peak reported in 1910.

Mathews grew by 16.5% (1,180 persons) between 1970 and 1990. The 2000 Census reported a population of 9,207 (an increase of 10.3%, or 859 persons since 1990). Much of the housing ion Mathews is traditional single family, but the County also has a growing number of manufactured homes and vacant seasonal housing (built typically for summer occupancy). Seasonal housing, in the form of cottages, recreational vehicles, rental mobile homes, and a few condominium units increased in number from 448 in 1970, to 583 in 1980, to 783 in 1990. Residents of seasonal housing are often not accounted for in the census counts because the units were not occupied during the census survey. It is estimated that only about 75% of the housing units in Mathews County are occupied year-round, adding significantly to the summer population of Mathews County.

2.8. Middlesex County

Middlesex County, comprising 132 square miles and 135 linear miles of shoreline, is located at the eastern end of the Middle Peninsula. The County is bounded by the Rappahannock River to the north, the Piankatank River and Dragon Swamp to the southwest, the Chesapeake Bay to the east, and Essex County to the northwest.

Settlement of the County began in 1640 with the County being officially formed in 1669 from a part of Lancaster County. The County's largest town, Urbanna, was established in 1680 and served as a port for shipping agricultural products. Urbanna served as the county seat of government until 1852, when it was moved to its present location in the village of Saluda. To the east, almost to Stingray Point, the village of Deltaville is located between the mouths of the Rappahannock and Piankatank Rivers. Once a major center for wooden boat building, the village remains a commercial and recreational center.

Middlesex has remained largely rural over the years with farming, forestry, fin and shell fishing providing the principal elements of the economic base. The relatively remote geographical location and difficulties with early ground transportation has caused the area to retain its rural character. The County population has increased 57.2% since 1950. Population peaked in 2000 with 9,932 persons, over twice the population reported in 1790 (4,140). Bridge and highway construction will continue to make commuting to work centers easier.

In 1990, nearly 30% of the housing units in the County were seasonal, approximately 28 times higher than the state average. Over 70% of the housing stock was built since 1960 and about 39% of the housing has been newly occupied since 1980, indicating an increasing number of new residents to the

County. Only 3.5% of the housing in Middlesex is multi-family, a figure significantly lower than the state average of 22.7%. Over 15% of the housing units are mobile homes (which is higher than the state average of 6.4%).

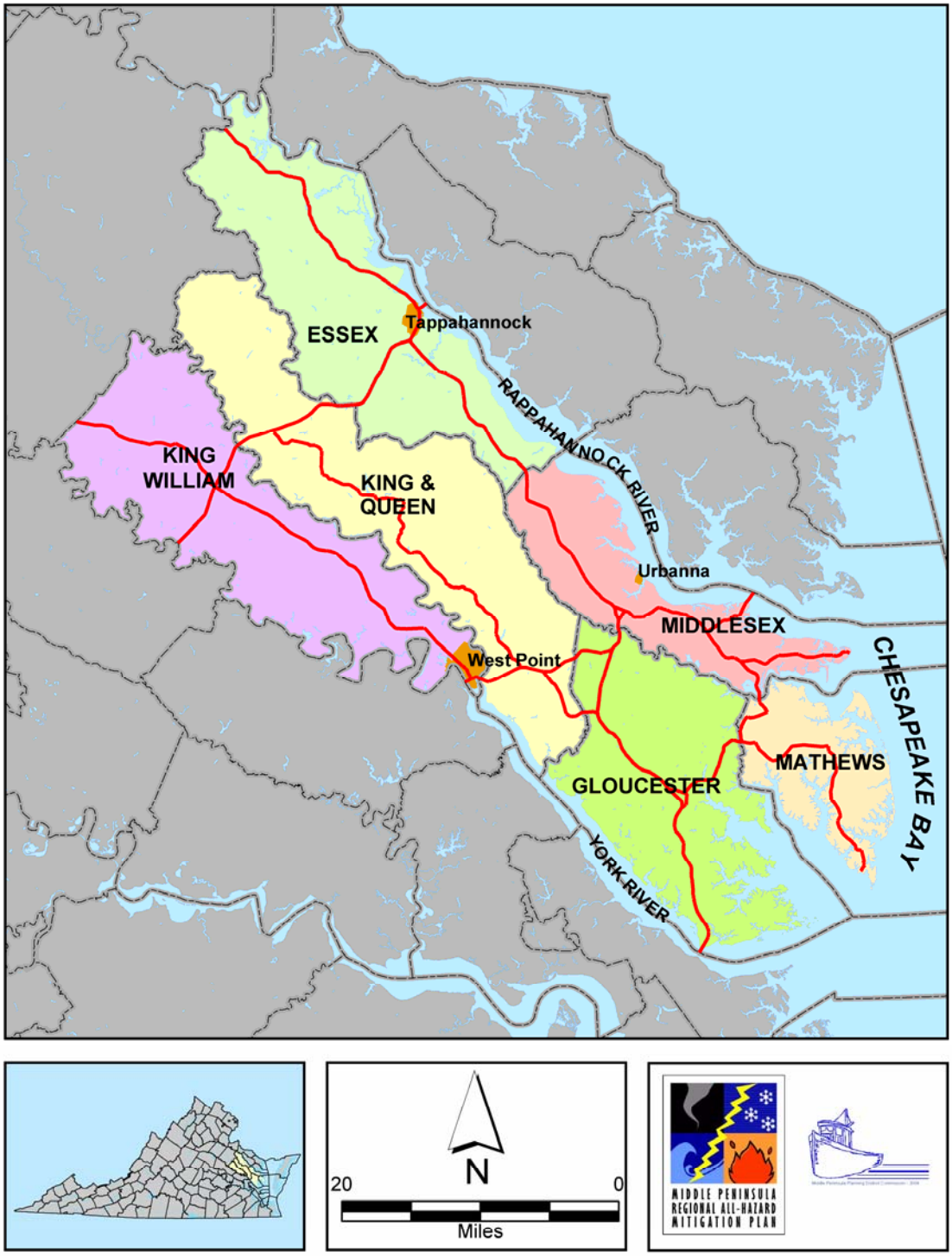
2.9. Town of Urbanna

The town of Urbanna is located in Middlesex County, on the Rappahannock River, on a finger of land bounded by Perkins Creek and Urbanna Creek. The Town is one of America's original harbor towns and is located approximately five miles from Saluda, the Middlesex County seat. Incorporated in 1902, the present Town boundary comprises an area of about one-half square mile. The Town operates an active boat harbor, maintained by the U.S. Army Corps of Engineers, which is the basis of fishing and recreational boating industries serving the area. The older part of the Town is concentrated along a grid of streets oriented to three main thoroughfares: Rappahannock Avenue, Cross Street, and Virginia Street.

The popular Urbanna Oyster Festival has been held in the town in November of each year since 1958. This annual event features oyster specialties and other Chesapeake Bay seafood, a parade, a fine arts exhibit, and visiting tall ships. Crowds for the two-day event now number nearly 75,000.

The population of Urbanna was 554 in 2000. The Town Administrator estimates that there is a seasonal swelling of the population to well above 1,000 people within the Town due to seasonal use of vacation homes.

The Middle Peninsula Region



3. The Planning Process

The Disaster Mitigation Act of 2000 (DMA 2K) planning regulations and guidance documents stress that each local government seeking the required FEMA approval of their mitigation plan must actively participate in the planning process, describe in detail the areas within the jurisdiction subject to natural hazards, identify specific projects to be eligible for funding, and have the local governing board adopt the plan. Active participation in the planning process included: 1) attendance at Regional Risk Assessment and Mitigation Planning (RAMP) Committee meetings; 2) providing data requested by the RAMP Committee; 3) reviewing and providing comments on draft plans; 4) advertising, coordinating, and participating in the Public Input meetings; and 5) coordination of plan adoption by the local governing Board. The planning process commenced in November 2003 when the Middle Peninsula Planning District Commission secured funding from the Virginia Department of Emergency Management to support the planning process and hired a Regional Planner to coordinate this planning effort. The final draft of the Middle Peninsula Regional Natural Hazard Mitigation Plan was submitted to VDEM and FEMA for review in March 2005.

3.1. ***Building the Planning Team.*** The Middle Peninsula Planning District Commission (MPPDC) staff (led by Janet Nestlerode, Regional Planner) coordinated meetings, provided staff support, and assisted the localities with the development of the Regional Natural Hazard Mitigation Plan. Representatives from each of County and Town were appointed by their respective local government administrators to represent their locality and serve on the Regional Risk Assessment and Mitigation Planning (RAMP) Advisory Committee. Typical local government representatives on the RAMP Committee included: County Administrators and Town Managers; Public Works, Building, and Zoning officials; Planners; GIS Technicians; Emergency Management Coordinators; and a Sheriff's Deputy.

Invitations to participate in the planning process were also extended to regional stakeholders that might have insight in Middle Peninsula hazards and/or a role in the implementation of proposed mitigation actions or policies. These individuals included representatives from other state agencies (Virginia Department of Emergency Management, Virginia Department of Health, Virginia Department of Conservation and Recreation, Tidewater Resource Conservation and Development Council), utility companies and districts (BFI Waste Management, Virginia Peninsula Public Service Authority, Virginia Dominion Power, Rappahannock Electric Cooperative, Verizon, Hampton Roads Sanitation District), colleges and universities within the region (Rappahannock Community College, Virginia Institute of Marine Science of the College of William and Mary), non-profit and community organizations (Middle Peninsula-Northern Neck Community Services Board, Bay Aging), neighboring communities (Northern Neck Planning District Commission, Hampton Roads Planning District

Commission), Transportation facilities (Middle Peninsula Regional Airport Authority), local businesses, and community leaders. Efforts to involve all of these Middle Peninsula stakeholders included invitations to attend meetings and serve on the RAMP, e-mails of meeting minutes and links to presentation slide shows and meeting summaries posted on the Middle Peninsula Regional Hazard Mitigation Plan website, and opportunities for input and to comment on all draft deliverables. A list of the participating RAMP Committee members is listed in Appendix 1. This RAMP Committee will remain an active group and will continue to meet beyond the submission of this Plan document to implement and periodically update this Plan.

3.2. ***Plan for Public Involvement – Engaging the Public.*** An open public planning process was utilized that provided opportunities for the public and stakeholders to comment upon the Plan during its development. Public involvement was discussed and agreed upon at the first Middle Peninsula Hazard Mitigation Plan Kick-Off meeting on January 29, 2004. A Middle Peninsula Hazard Mitigation Plan web site, hosted by the Middle Peninsula Planning District Commission, was established to serve as an information and communication portal to provide information and plan development updates for all of the RAMP committee members, the general public, and other interested parties. Slides from meeting presentations, meeting agenda and summaries, FEMA guidebooks, and other pertinent links were posted. Drafts of the Regional Natural Hazard Mitigation Plan were also linked from this site for review and comment. The URL address of this website (www.mppdc.com/ahmp) was publicized in the Middle Peninsula Planning District Commission newsletter (which is both distributed by mail and posted on the MPPDC web site), in press releases distributed to local newspapers, and through a newspaper article published in the Gloucester-Mathews Gazette Journal featuring a description of the Middle Peninsula's Hazard Mitigation Planning effort. A survey questionnaire, designed to identify hazard concerns and allow the opportunity to suggest policies and projects to help lessen the impact of future hazard events, was also posted on the web site to promote public participation in the mitigation planning process. While only two surveys were completed by interested citizens and returned to the MPPDC office, additional citizen input was provided by individuals visiting the MPPDC office, often for other business, who learned of this planning effort and offered anecdotal information and suggested mitigation strategies that they thought would make their communities more disaster-resistant. Members of the RAMP committee also completed this survey and results were summarized and discussed at the second meeting of the RAMP committee on April 27, 2004.

A formal Public Input Meeting was held on March 9, 2005 at the Middle Peninsula Planning District Commission Office following the completion of the Hazard Identification and Risk Analysis section of the Plan document and prior to the Plan approval. This meeting was publicized in quarter-page newspaper ads (Appendix 2) placed in each of the newspapers of record for Middle Peninsula

localities: Gloucester-Mathews Gazette Journal, Southside Sentinel, Tidewater Review, and Rappahannock Times. A draft of the Plan document was made available on the Middle Peninsula Hazard Mitigation Plan web site for public review. Four citizens attended (two from Gloucester County, and one each from Middlesex and Essex Counties) and provided comments. Stakeholder and public comments were reflected in the preparation of the Plan, including those sections addressing mitigation goals and action strategies.

Of note, one citizen at the Public Meeting expressed concern about proposed mitigation strategies within the Plan and FEMA requirements for future mitigation funding proposals. It was suggested that projects requesting future federal mitigation funding be required to be included in a FEMA-Approved Hazard Mitigation Plan before funding is approved.

3.3. ***Coordination with other Departments and Agencies.*** The RAMP committee determined early in the planning process that involving other state and federal agencies could facilitate data collection, mitigation strategy development, and the plan approval process. Representatives from the following agencies were invited to participate on the RAMP Committee:

- FEMA Region III (Mitigation Planning Division)
- Virginia Department of Emergency Management (Mitigation Planning Division, Regional Coordinators from Regional Field Offices 1 and 5, and the Preparedness Training and Exercises Division)
- USDA (Tidewater Resource Conservation and Development Council)
- Virginia Department of Conservation and Recreation (Division of Dam Safety and Floodplain Management)

In addition to the agencies above, the RAMP committee used resources of the agencies listed below in the development of the Plan. Technical data, reports, and studies were obtained directly from these agencies or through web-based resources:

- National Climatic Data Center (NCDC)
- United States Army Corps of Engineers (USACE)
- Virginia Department of Emergency Management (VDEM)
- Virginia Department of Conservation and Recreation (DCR)
- Virginia Department of Environmental Quality (VDEQ)
- Middle Peninsula Planning District Commission (MPPDC)
- Federal Emergency Management Agency (FEMA)
- National Oceanic and Atmospheric Administration, (NOAA)
- Virginia Department of Forestry (VDOF)
- Virginia Department of Health (VDH)
- United States Geological Survey (USGS)
- West Virginia University Extension Service

3.4. *Other Community Planning Efforts and Hazard Mitigation Activities:* Coordination with other community planning efforts is paramount to the success of this Plan. Hazard mitigation planning involves identifying existing community policies, tools, and actions that will reduce a community's risk and vulnerability to natural hazards. The RAMP Committee utilized information included a variety of plans, studies, reports, municipal ordinances, and building codes and incorporated information contained therein into the Regional Natural Hazard Mitigation Plan. Other planning documents used during the development of this Plan include:

- Essex County, Virginia, Comprehensive Plan (1998)
- Essex County Code
- Essex County Emergency Operations Plan
- Comprehensive Plan, Gloucester County, Virginia (1991, Amended 2001)
- Code of the County of Gloucester, Virginia (2004, Supplement No. 32)
- Gloucester County Emergency Operations Plan
- Comprehensive Plan King and Queen County, Virginia (1994)
- King and Queen County Code
- King and Queen County Emergency Operations Plan
- Code of the County of King William, Virginia
- Comprehensive Plan Update, King William County (2003)
- King William County, Virginia, Emergency Operations Plan
- Comprehensive Plan, Mathews County, Virginia (2000)
- County of Mathews, Virginia, Emergency Operations Plan
- Code of the County of Mathews County, Virginia (updated 2003)
- Comprehensive Plan, Middlesex County, Virginia (update, 2001)
- County of Middlesex, Virginia, Emergency Operations Plan
- Tappahannock, Virginia Comprehensive Plan (1998)
- Comprehensive Plan, Town of Urbanna, Virginia (1995)
- Urbanna Town Code
- A Comprehensive Plan: The Town of West Point, Virginia (1994)
- Town of West Point Emergency Operations Plan
- Virginia Uniform Statewide Building Code
- Coastal Construction Manual (FEMA 55, 3rd Edition, June 2000)
- Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for Middle Peninsula localities
- Virginia Hurricane Surge Atlas (Gloucester, Mathews, and Middlesex Counties)
- Census 2000
- Emergency 911 structure data for each Middle Peninsula locality

3.5. *RAMP Committee Meetings and the Planning Process:*

The RAMP Committee met five times during the planning process and communicated via e-mail during the intervening periods between meetings. Attendance and agendas for each of the RAMP Committee meetings are on file at the Middle Peninsula Planning District Commission office. MPPDC Staff also periodically presented Plan development updates at monthly meetings of the Middle Peninsula Local Government Administrators and the Middle Peninsula Local Planners (many of whom also sit on the RAMP Committee). Updates were also presented at the March 2004 and January 2005 meetings of the Middle Peninsula Planning District Commission.

The first RAMP Committee meeting, convened on January 29, 2004, was a Kick-Off Meeting to explain the impetus for developing a Natural Hazards Plan for the Middle Peninsula. At this meeting, MPPDC staff led a discussion on the scope, schedule, and additional public outreach initiatives for public involvement. They also identified additional potential RAMP Committee members and stakeholders not already on the invitation list to be included in the planning effort. A survey questionnaire, designed to identify hazard concerns and allow the opportunity to suggest policies and projects to help lessen the impact of future hazard events, was distributed.

On March 15, 2004, members of the RAMP committee and other Emergency Management officials and First Responders from Middle Peninsula localities met to discuss the relevancy of emergency notification systems to the Middle Peninsula and the possibility of including the installation of such a system as a mitigation strategy in the Plan. A representative from *Reverse-911*, an emergency communication system designed to send rapid, targeted messages via the telephone to alert the community in the event of an emergency, presented an overview of this technology.

On April 28, 2004, the RAMP Committee convened once again to review a series of memos from VDEM explaining some of the plan review, adoption, and approval criteria, participation requirements, and funding issues. The results of the hazard survey questionnaire distributed at the January meeting were reviewed and discussed. The RAMP Committee completed a Hazard Vulnerability and Assessment exercise, recommended by VDEM, to identify and prioritize regional hazards. Results were complied, summarized, and posted on the Plan web site. The RAMP Committee members from each locality were asked to complete a series of worksheets prior to the next RAMP Committee meeting. These worksheets requested information from each locality profiling hazard events, inventorying assets, and estimating losses for each of the hazards identified as a high priority during the Hazard Vulnerability and Assessment exercise.

At the next RAMP Committee meeting, held July 28, 2004, the RAMP Committee further evaluated findings outlines in the worksheets profiling hazard events, inventorying assets, and estimating losses for each hazard. The committee discussed obtaining additional information needed from each locality to complete the Hazard Inventory and Risk Assessment (HIRA) section of the Hazard Mitigation Plan.

The RAMP Committee met on February 9, 2005 to review the findings summarized in the HIRA section of the Plan document. Attendees participated in a mitigation strategy brain-storming exercise. A variety of potential mitigation projects were proposed for inclusion in the 'Mitigation Strategy' section of the Regional Natural Hazards Mitigation Plan document.

4. Hazard Identification and Risk Assessment

The Hazard Identification and Risk Assessment (HIRA) for the Middle Peninsula Regional Natural Hazard Mitigation Plan was conducted primarily by staff of the Middle Peninsula Planning District Commission and the Regional Risk Assessment and Mitigation Planning (RAMP) Advisory Committee (Appendix 1). The following chapter of the Plan will cover the following three main requirements for the HIRA:

1. *Hazard Analysis*
2. *Assessing Vulnerabilities*
3. *Estimating Potential Losses*

4.1. ***Hazard Analysis:***

Based on the Federal Guidelines (Disaster Mitigation Act of 2000, *§201.1(b)*) this HIRA only focused on natural hazards and their impact on the Middle Peninsula. It measured potential loss of life, personal injury, economic impairment, and property damage resulting from these natural hazards that threaten the Middle Peninsula. The Middle Peninsula natural hazard risk assessment was performed in two steps – a *Hazard Analysis* and a *Vulnerability Assessment*. The hazard analysis identified and described the types of hazards to which the region is vulnerable, examined historical accounts of past hazard events, and created a profile for the most threatening or likely hazards. The profile evaluated the location, extent, magnitude, probabilities, and likelihood of occurrence of the natural hazards. While there are many different natural hazards that may affect the six counties and three towns of the Middle Peninsula, some hazards are more likely to cause significant impacts and damages than others. Additionally, because of the large geographic area and varying topography and population densities of different communities within the Middle Peninsula, these vulnerabilities and risks vary among and within localities. The vulnerability analysis attempted to quantify the potential impacts and identify the hazards that pose the greatest possible risk using “best available data”, as emphasized in the Virginia Department of Emergency Management’s (VDEM) Mitigation Planning Guidance Memorandum #1a (dated October 25, 2003). Once these hazards were identified, further analysis *estimated potential losses* due to hazards of which the Middle Peninsula was deemed most vulnerable.

The RAMP Committee evaluated an extensive list of natural hazards that could potentially affect the Middle Peninsula, including:

- Hurricanes
- Ice Storm
- Tornadoes
- Coastal Flooding / Nor'easters
- Coastal / Shoreline Erosion
- Snow Storm
- Riverine Flooding
- Wildfire
- High Wind / Windstorms
- Dam Failure
- Drought
- Lightning
- Earthquake
- Shrink-swell Soils
- Extreme Cold
- Extreme Heat
- Land Subsidence/Karst
- Landslides
- Tsunami
- Volcano

Using a modified Hazard Vulnerability Tool worksheet provided by VDEM (originally designed to estimate medical center hazard and vulnerability by Kaiser Permanente), readily available data, and local knowledge and observations, the Middle Peninsula RAMP Advisory Committee evaluated these hazards. The RAMP Committee chose five criteria to rank the hazards from highest to lowest priorities. Those five categories included probability based on past events, the potential impacts to structures, primary impacts (percentage of damage to a typical structure or industry in the community), secondary impacts (based on impacts to the community at large), and potential mitigation options. The definitions given in Table 1 were used as a standard for evaluation of all the hazards. Table 2 represents the committee's prioritization criteria and how each hazard was ranked.

By examining the historical occurrence of each hazard, along with the potential impacts, the hazards that pose the most significant risks to the Middle Peninsula were identified. This risk analysis allowed the Middle Peninsula to focus its hazard mitigation plans on the hazards that will most likely cause future impacts to the community. The Middle Peninsula RAMP Advisory Committee prioritized and ranked these hazards based on the criteria above. The four hazards that had the highest relative risk based on this analysis were Hurricanes, Winter Ice

Storms, Tornadoes, and Coastal Flooding. These hazards are considered "Critical Hazards" to the Middle Peninsula.

Hazards considered "Non-Critical" are those that have occurred very infrequently, or have not occurred at all, in the available historical records and are not considered a widespread threat resulting in significant losses of property and life in the Middle Peninsula. These Non-Critical hazards included: Lightning, Earthquakes, Shrink-swell Soils, Extreme Cold, Extreme Heat, Land Subsidence/Karst, Landslides, Tsunami, and Volcano.

The remaining hazards, considered "Moderately Critical", are those that have historically occurred in the Middle Peninsula, yet ranked lower than the Critical Hazards in terms of risk during the hazard prioritization exercise. These Moderately-Critical hazards included: Winter Storms (snow), Riverine Flooding, Wildfire, High Wind / Windstorms (excluding tornados), Dam Failure, and Drought.

In order to focus on the most significant hazards to the Middle Peninsula, only the Critical Hazards are addressed in this document. The other hazards are described briefly for completeness (as required by the Disaster Mitigation Act of 2000, *§201.6(c)(2)(i)*).

Table 1: *Prioritization Criteria for Hazards on the Middle Peninsula*

Probability

- Frequency of occurrence based on historical data of all potential hazards

Level

1 Unlikely (less than 1% occurrence: no events in the last 100 years)
2 Likely (between 1% and 10% occurrence: 1-10 events in last 100 years)
3 Highly Likely (over 10% occurrence: 11 events or more in last 100 years)

Affected Structures

- Number of Structures affected

Level

0 None
1 Small (limited to 1 building)
2 Medium (limited to 2-10 buildings)
3 Large (over 10 buildings)

Primary Impacts

- Based on percentage of damage to a typical structure or industry in the community

Level

0 None
1 Negligible (less than 3% damage)
2 Limited (between 3% and 49% damage)
3 Critical (more than 49% damage)

Secondary Impacts

- Based on impacts to the community at large

Level

0 None
1 Negligible (no loss of function, no displacement time, no evacuations)
2 Limited (some loss of function, displacement time, some evacuations)
3 Critical (major loss of loss of function, displacement time, major evacuations)

Mitigation Options

- Number of cost effective mitigation options

Level

0 None
1 Many (over 3 cost effective mitigation options)
2 Several (2-3 cost effective mitigation options)
3 Few (1 cost effective mitigation option)

Table 2: *Prioritization Worksheet for Hazards on the Middle Peninsula*

HAZARD TYPE	PROBABILITY	AFFECTED STRUCTURES	PRIMARY IMPACTS	SECONDARY IMPACTS	MITIGATION OPTIONS	RISK	RANK
	Likelihood hazard will occur	*Number of Structures affected*	*Damage to typical structure or industry in the community*	*Based on impacts to the community at large*	*Preplanning*	*threat increases with percentage*	
SCORE	1 = Unlikely 2 = Likely 3 = Highly Likely	0 = None 1 = Small 2 = Medium 3 = Large	0 = N/A 1 = Negligible 2 = Limited 3 = Critical	0 = N/A 1 = Negligible 2 = Limited 3 = Critical	0 = None 1 = Many 2 = Several 3 = Few	0 - 100%	
Hurricanes	3	3	3	3	2	**92%**	1
Winter Storm (Ice)	3	2	3	2	2	**75%**	2
Tornadoes	3	2	2	2	2	**67%**	3
Coastal Flooding	3	2	2	2	2	**67%**	3
Coastal / Shoreline Erosion	3	3	0	1	3	**58%**	4
Winter Storm (Snow)	2	3	3	2	2	**56%**	5
Riverine Flooding	2	3	2	2	2	**50%**	6
Wildfire	2	3	1	2	2	**44%**	7
High Wind / Windstorms	2	2	1	2	3	**44%**	7
Dam Failure	2	2	1	2	1	**33%**	8
Drought	3	0	0	2	1	**25%**	9
Lightning	2	0	1	1	1	**17%**	10
Earthquake	2	0	0	0	3	**17%**	10
Shrink-swell Soils	2	1	1	0	1	**17%**	10
Extreme Cold	2	0	1	1	0	**11%**	11
Extreme Heat	1	0	1	1	0	**6%**	12
Land Subsidence/Karst	1	0	0	0	0	**0%**	-
Landslides	1	0	0	0	0	**0%**	-
Tsunami	1	0	0	0	0	**0%**	-
Volcano	1	0	0	0	0	**0%**	-
AVERAGE SCORE	**2.05**	**1.30**	**1.10**	**1.25**	**1.35**	**34%**	

4.2. *Hazards considered "Non-Critical Hazards" to the Middle Peninsula:*

The following sections describe natural hazards that are uncommon throughout the Middle Peninsula region and deemed "Non-Critical Hazards" to the Middle Peninsula by the RAMP Committee. These hazards are those that have occurred very infrequently, or have not occurred at all, in the available historical records and are not considered a widespread threat resulting in significant losses of property and life in the Middle Peninsula.

4.2.1. Lightning

Virginia averages 35 to 45 thunderstorm days per year statewide (Watson 2001). Thunderstorms are generally beneficial because they provide needed rain for crops, plants, and reservoirs. Thunderstorms can occur any day of the year and at any time of the day, but are most common in the late afternoon and evening during the summer months. About five percent of thunderstorms become severe and can produce tornadoes, large hail, damaging downburst winds, and heavy rains causing flash floods. Thunderstorm can develop in less than 30 minutes, allowing little time for warning. All thunderstorms produce lightning, which can be deadly. The National Weather Service does not issue warnings for ordinary thunderstorms nor for lightning. The National Weather Service does highlight the potential for thunderstorms in the daily forecasts and statements. The Virginia Department of Emergency Management suggests that the public be alert to the signs of changing weather, such as darkening skies, a sudden wind shift, and drop in temperature, and having a warning device such as NOAA Weather Radio.

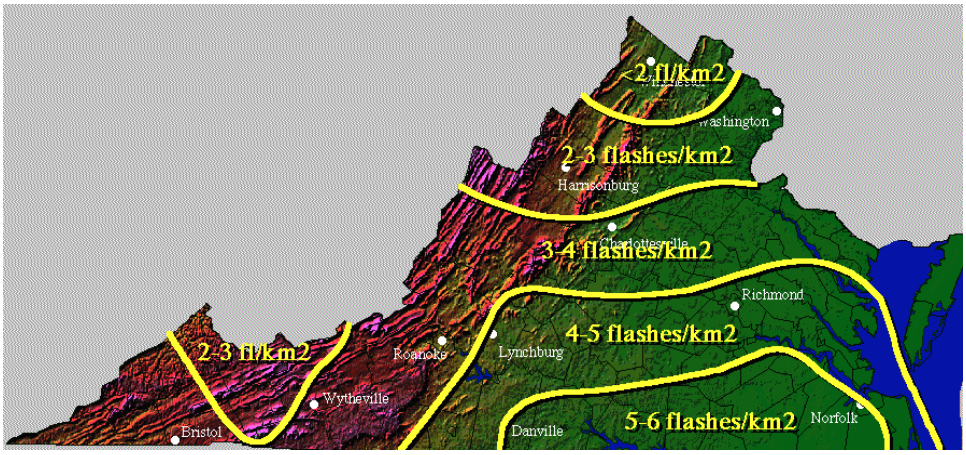


Figure 1: *Lightning Flash Density Map computed for 1989 (Electric Power Institute), courtesy of the University of Virginia, Climate Division:*

www.climate.virginia.edu/climate/lightning.density.html

Lightning can strike up to 10 to 15 miles from the rain portion of the storm. The lightning bolt originates from the upper part of the thunderstorm cloud known as the anvil. A thunderstorm can grow up to 8 miles into the atmosphere where the strong winds aloft spread the top of the thunderstorm cloud out into an anvil. The anvil can spread many miles from the rain portion of the storm but it is still a part of that storm. Lightning, from the anvil, may strike several miles in advance of the rain. Lightning bolts may also come from the side or back of the storm,

striking after the rain and storm have seemed to pass, or hitting areas that were totally missed by the rain.

Between 1959 and 2000, lightning killed 58 people in Virginia and injured at least 238 people. Many additional injuries from lightning go unreported or are not captured by NWS data collection techniques. Nationally, from 1959 through 1994, 13,057 people were casualties to lightning with 3239 deaths. Most deaths were males between the ages of 20 and 40 years old who were caught outdoors on ball fields, near open water, or under trees.

A national network of 114 lightning ground stroke detectors was put in place by the Electric Power Research Institute (EPRI), a private organization, that serves the needs of power companies and other subscribers interested in lightning across the country (Virginia Climate Advisory, 1992). These detectors sense the characteristic electromagnetic impulses of cloud-to-ground lightning strikes that occur up to several hundred kilometers away. Then, by using triangulation techniques, the network is able to describe the location of every ground strike that it detects in the continental U.S. (Figure 1). Its is important to realize that the contours on the map are very general and because accurate, long term records of lightning strikes do not exist, the illustration may not be representative of long-term patterns. Historic data show that the Middle Peninsula is at a low risk of suffering damages from lightening and thunderstorms, yet it is important to note that thunderstorms and lightening can be very dangerous and can accompany hurricanes and other severe weather events.

4.2.2. Earthquakes

An earthquake is a sudden movement or trembling of the Earth, caused by the abrupt release of strain that has accumulated over a long time. For hundreds of millions of years, the forces of plate tectonics have shaped the Earth as the huge plates that form the Earth's surface slowly move over, under, and past each other. Sometimes the movement is gradual; at other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free and result in an earthquake (Shedlock and Pakister 1997). If the earthquake occurs in a populated area, it may cause deaths, injuries, and extensive property damage.

During an earthquake when the ground is shaking, it experiences acceleration. The peak acceleration (PA) is the largest acceleration recorded by a particular station during an earthquake (expressed as %g). When acceleration acts on a physical body, the body experiences the acceleration as a force. The force we are most experienced with is the force of gravity, which causes us to have weight. Units of acceleration are measured in terms of g, the acceleration due to gravity. For example, an acceleration of 11 feet per second per second is 11*12*2.54 = 335 cm/sec/sec. The acceleration due to gravity is

980 cm/sec/sec, so an acceleration of 11 feet/sec/sec is about 335/980 = 0.34 g. Expressed as a percent; 0.34 g is 34 %g.

The United States Geological Survey (USGS) rates the susceptibility of areas of the United States to earthquakes and has published risk maps, which give the probability of various levels of ground motion being exceeded in 50 years. An approximate threshold for shaking that causes building damage (for pre-1965 dwellings or dwellings not designed to resist earthquakes) is 10 percent g. According to USGS predictions, the Middle Peninsula is located in an area of low (0-2%g) seismic risk contours (Figure 2), which means that there is a 1 in 475 chance of normal ground motion exceeding 2-3%g in a given year.

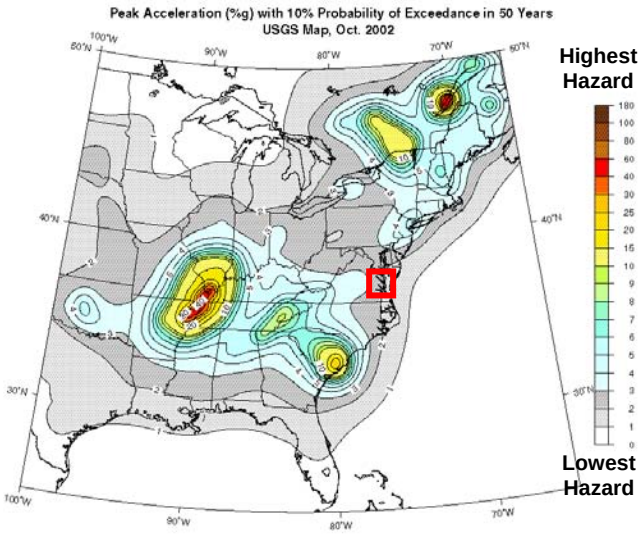


Figure 2: *Predicted earthquake hazard for the eastern United States, depicted by contour values of earthquake ground motions that have a 10% probability of being exceeded in 50 years. The Middle Peninsula of Virginia (highlighted by the red square on the map at right) falls within the 2-3%g contour. Image courtesy of Frankel et al. (1997).*

Historical data is supportive of this low risk assessment. Virginia has had over 160 earthquakes since 1977 of which 16% were felt (Stover and Coffman 1993). This equates to an average of one earthquake occurring every month with two felt each year. The largest earthquake to occur in Virginia is the 1897 magnitude 5.8 Giles County Earthquake. This earthquake is the third largest in the eastern US in the last 200 years and was felt in twelve states. Seismic activity (seismicity) has been known for several decades to be strongest in and around Giles County and in central Virginia. This led researchers at the Virginia Tech Seismological Observatory to concentrate seismic monitoring stations in these two areas, as shown in Figure 3, which shows earthquakes (circles, scaled to magnitude) in and near Virginia from 1774 through 1994 (Stover and Coffman 1993). No earthquake epicenters were recorded to have fallen within the area of the Middle Peninsula.

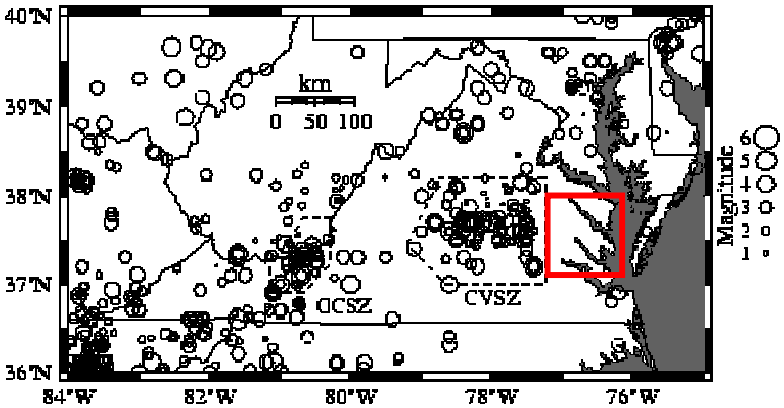


Figure 3: *Historical earthquake epicenters in and near Virginia from 1774 through 1994, depicted by circles scaled to magnitude. The Middle Peninsula of Virginia (highlighted by the red square on the map at right) is void of any historic earthquake epicenters. Image courtesy of Virginia Tech Seismological Observatory (2001).*

4.2.3. Shrink-swell Soils

Various areas of the Middle Peninsula have expandable soils that may have the potential to shrink and /or swell with changes in moisture content. The sensitivity of a soil to shrink or swell is related to the amount of clay minerals in the soil. These soils are very affected by changes in moisture content. They have a high tendency to expand (swell) when receiving a lot of moisture and contract (shrink) during times of little or no precipitation. Soils that have a high shrink-swell rating may cause damage to buildings, roads, or other structures if not compensated for by engineering. Special design is often needed for construction in such soils.

House Joint Resolution No. 243 (passed by the Virginia House of Delegates and Senate in March 1996) requires mandatory education for Virginia building code officials on the issue of expansive soils. Where expansive or other problem soils are identified, various methods for responding to them are permitted, including removal and replacement of soils, stabilization by dewatering or other means, or the construction of special footings, foundations, or slabs on how to deal with such soil conditions. This mandatory education is intended to provide guidance on the type of construction techniques to be employed where problem soils are present. While not preventing a site from being used, a high shrink-swell capability places a potential restriction on the size and weight of the building that may be built upon it.

Shrink-swell soils are not specifically addressed in the Essex County Comprehensive Plan (1998), however soils associations are generally described. The Rappahannock-Molena-Pamunkey soil association is located on tidal marshes along the Rappahannock River and along floodplain of major creeks that feed into the River. The soil association is predominately Rappahannock soils, which are not suitable for any type of development because of flooding, high water table, and high organic content. These soils are very poorly drained with a surface layer of loam and subsurface of loam, fine sandy loam, and clay loam. About half of the land within this soil association is farmed; the rest is tidal and freshwater marshes. Some areas are used for waterfront development, but seasonal wetness, flooding, and unsuitability for septic systems limits the uses of this land. The suitability of the soil for septic systems and for agriculture is a prime consideration in making general land use policy decisions in Essex County.

Some of the area of the Town of Tappahannock is also on soils of the Rappahannock-Molena-Pamunkey soil association, primarily along Hoskin's Creek and Tickner's Creek (Town of Tappahannock Comprehensive Plan, 1991). These areas are not suitable for development, therefore eliminating potential problems associated with structures built on shrink-swell soils.

Shrink-swell soils are not specifically addressed in the Gloucester County Comprehensive Plan (amended 2001). However, in an analysis of soil suitability for development, clayey soils account for roughly 6,600 acres, or approximately 5% of the area of the county. Because these conditions are often coincident with shrink-swell soils, this is an approximate estimation of shrink-swell soil conditions within the county. These clayey soils are also listed as being unsuited for housing septic systems. The Gloucester County Land Use Plan generally coordinates the Bayside Conservation District and Resource Conservation District with large areas of soils unsuitable for septic tank use or otherwise unsuitable for high density or commercial development due to physical constraints.

Shrink-swell soils are also not addressed in the King and Queen County Comprehensive Plan (1994).

Only one area in King William County (Bohicket) is rated high for shrink-swell soils (King William Comprehensive Plan 2003). According to the Comprehensive Plan, the County uses the Soil Survey results in formulating future land use policies. Goals and implementation strategies within the County's Comprehensive Plan include increasing public awareness of potential problems resulting from building on soils with moderate to high shrink-swell characteristics, discouraging development in areas that are unsuited for development because of soil conditions, continue policies that require soil feasibility studies prior to approval of residential rezonings, include in the plan review process a requirement for evaluating shrink-swell soil qualities, and provide builders and developers with advice and information on shrink-swell qualities of soils and the need to evaluate these conditions before committing to construction. Shrink-Swell soils are not addressed in the Town of West Point's Comprehensive Plan (1994).

High shrink-swell soils are present in the northeastern tip of Mathews County and along the waterfront of the rivers and streams. Most of the wetlands in the County and most of the areas within the Chesapeake Bay Resource Protection Areas (protected from development by the Chesapeake Bay Preservation Act, adopted by the Virginia General Assembly in 1988) are shrink-swell soils. These soils account for just a little more than 7,000 acres of Mathews County.

According to the Middlesex County Comprehensive Plan (2001), shrink-swell soils within Middlesex County limit community development in the Ackwater, Craven, and Slagle soil series. Together, the lands comprised of these soils make up approximately 12,350 acres, or roughly 15% of the area of the county. Community development in these areas is restricted because the limitations caused by these soils cannot normally be overcome without exceptional, complex, or costly measures.

Only low to moderate shrink-swell soil potential exists in the Town of Urbanna, leaving the soils of the Town generally moderately suited for development (Town of Urbanna Comprehensive Plan, amended 1995). The Town's Comprehensive Plan states that individual sites should be examined in detail prior to any development.

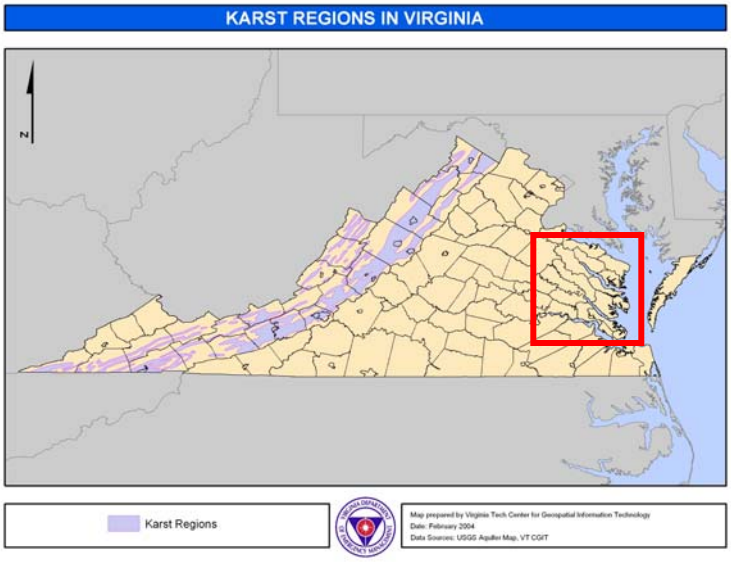
4.2.4. Extreme Cold and Extreme Heat

Extreme cold temperatures are not an annual event in Virginia. Although wind chill advisories are issued nearly every year, especially in Western and Northern portions of the state, life-threatening extreme cold, requiring wind chill warnings, is a rare occurrence in the Middle Peninsula. The frequency of occurrence is dependent entirely upon the extreme cold criteria used (i.e. wind chill vs. air temperature). The primary impact of extreme cold is increased potential for frostbite, hypothermia, and potentially death because of over-exposure to extreme cold. Some secondary hazards extreme/excessive cold present is a danger to livestock and pets, and frozen water pipes in homes and businesses.

Extreme heat, generally associated with drought conditions, is a phenomenon that is generally confined to the months of July and August, although brief periods of excessive heat have occurred in June and September. The primary impact of extreme heat is increased potential for hyperthermia, which can be fatal to the elderly and infirmed. In addition, there is an increased risk of dehydration, if proper steps are not taken to ingest adequate amounts of non-alcoholic fluids. Extreme heat can be defined either by actual air temperature, or by the heat index, which relates the combined effects of humidity and air temperature on the body. Extreme heat is not an annual event in The Middle Peninsula. Although heat advisories are issued near every year, especially in the urban areas of Northern Virginia, life-threatening extreme heat is a rare occurrence in the Middle Peninsula region. The frequency of occurrence is dependent entirely upon the extreme heat criteria used (i.e. heat index vs. air temperature). The impact of extreme heat is most prevalent in urban areas, which are not found in the Middle Peninsula. Secondary impacts of excessive heat are severe strain on the electrical power system, and potential brownouts or blackouts.

4.2.5. Land Subsidence/Karst

Figure 4: Karst Regions in Virginia (map courtesy of the Virginia Department of Emergency Management) are primarily limited to the mountainous regions of the state. The area encompassing the Middle Peninsula is highlighted on the map with a red square.



Land subsidence is the lowering of surface elevations due to changes made underground. The USGS notes that land subsidence is usually caused by human activity such as pumping of water, oil, or gas from underground reservoirs. Land subsidence often occurs in regions with mildly acidic groundwater and the geology is dominated by limestone, dolostone, marble or gypsum. Karst is the term used to refer to geology dominated by limestone and similar soluble rocks. The acidic groundwater dissolves the surrounding geology creating sinkholes. Sinkholes are classified as natural depressions of the land surface. Areas with large amounts of karst are characterized by the presence of sinkholes, sinking streams, springs, caves and solution valleys. These conditions do not occur in the Middle Peninsula.

4.2.6. Landslides

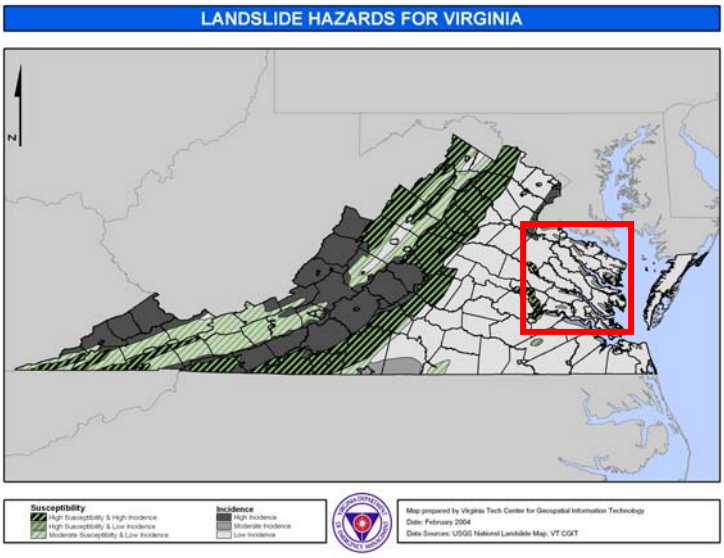


Figure 5: Landslide Hazard Regions in Virginia (map courtesy of the Virginia Department of Emergency Management) are primarily limited to the western and southwestern regions of the state. The area encompassing the Middle Peninsula is highlighted on the map with a red square.

Similar to karst, Figure 5 above shows that most landslide hazards are located in western and southwestern Virginia. The term "landslide" is used to describe the downward and outward movement of slope-forming materials reacting under the force of gravity. The term covers a broad category of events, including mudflows, mudslides, debris flows, rock falls, rock slides, debris avalanches, debris slides, and earth flows. These terms vary by the amount of water in the materials that are moving.

Several natural and human factors may contribute to or influence landslides. How these factors interrelate is important in understanding the hazard. The three principal natural factors are topography, geology, and precipitation. The principle human activities are cut-and-fill construction for highways, construction of buildings and railroads, and mining operations. Landslides can cause serious damage to highways, buildings, homes, and other structures that support a wide range of economies and activities. Landslides commonly coincide with other natural disasters. Expansion of urban development contributes to greater risk of damage by landslides.

As depicted in Figure 5, the Middle Peninsula region is within an area of low susceptibility to landslides with low to moderate previous incidence.

4.2.7. Tsunami

A tsunami is a wave, or series of waves, generated in a body of water by a disturbance that vertically displaces (moves up or down) the water column. Earthquakes, landslides, explosions, volcanic eruptions, and meteorites can generate tsunamis (Musick 2005). Earthquakes can cause tsunamis when large areas of the sea floor move and vertically displace the overlying water. If the sea floor movement is horizontal, a tsunami is not generated. After a large-scale vertical sea-floor movement, waves are formed when the displaced water mass travels across the surface of the ocean.

Tsunamis along the east coast of the United States are extremely unlikely. However, geologists Steven N. Ward and Simon Day (2001) describe a landslide that could cause a collapse of a massive piece of the west flank of Cumbre Vieja Volcano on La Palma Island in the Canary Islands (off the western coast of Africa) into the Atlantic Ocean. This could generate tsunami waves that arrive on the coasts of the Americas as much as 70 ft in height. The scientists used modeling techniques to produce their conclusion of this "worst case scenario". The Cumbre Vieja Volcano last erupted in 1949 and shows no signs of activity.

4.2.8. Volcano

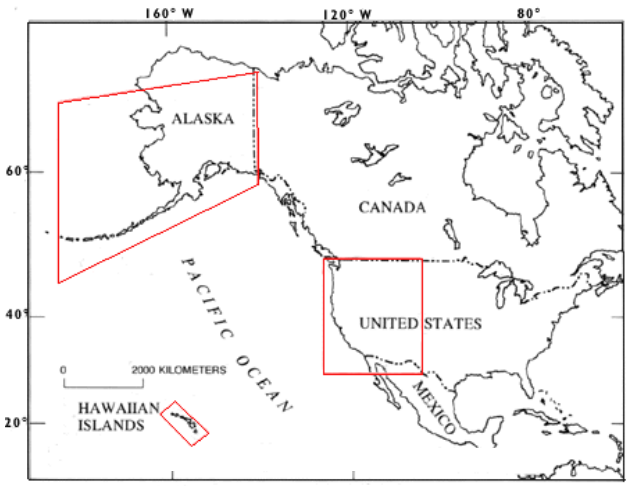


Figure 6: Map of United States showing areas where active volcanoes are located (image courtesy USGS).

The United States ranks third, behind Indonesia and Japan, in the number of historically active volcanoes. In addition, about 10 percent of the more than 1,500 volcanoes that have erupted in the past 10,000 years are located in the United States (Brantley 1997). Most of these volcanoes are found in the Aleutian Islands, the Alaska Peninsula, the Hawaiian Islands, and the Cascade Range of the Pacific Northwest; the remainder are widely distributed in the western part of the Nation. Volcanoes are considered hazardous because of the dangers associated with pyroclastic flows emitted from them during an eruption (USGS 1999). Pyroclastic flows are high-density mixtures of hot, dry rock fragments and hot gases that move away from the vent that erupted them at high speeds. They

may result from the explosive eruption of molten or solid rock fragments, or both. They may also result from the non-explosive eruption of lava when parts of dome or a thick lava flow collapses down a steep slope. A pyroclastic flow will destroy nearly everything in its path. With rock fragments ranging in size from ash to boulders traveling across the ground at speeds typically greater than 80 km per hour, pyroclastic flows knock down, shatter, bury or carry away nearly all objects and structures in their way. The extreme temperatures of rocks and gas inside pyroclastic flows, generally between 200°C and 700°C, can cause combustible material to burn, especially petroleum products, wood, vegetation, and houses. The Eastern United States does not have any active volcanoes; therefore, pyroclastic flows are not considered a critical hazard to the Middle Peninsula.

4.3. Hazards considered "Moderately-Critical Hazards" to the Middle Peninsula:

The following sections describe natural hazards that have historically occurred in the Middle Peninsula, yet ranked lower than the Critical Hazards in terms of risk during hazard prioritization. These hazards were deemed "Moderately-Critical Hazards" to the Middle Peninsula by the RAMP Committee.

4.3.1. Snow Storm

The winter months can bring a wide variety of natural hazards to the Middle Peninsula, including blizzards, snowstorms, ice, sleet, freezing rain, and extremely cold temperatures. All of these weather events can be experienced throughout the state, depending on the depth of cold air that is in place over the region when the storm event comes. The Middle Peninsula's biggest winter weather threats come from Northeasters or Nor'easters. These large storms form along the southern Atlantic coast and move northeast into Virginia along the Mid-Altlantic coast. These events are explained in detail in the following section describing Critical Hazards to the Middle Peninsula, under the sub-heading "Winter Ice Storms". Winter storm events can bring strong winds and anything from rain to ice to snow to even blizzard conditions over a very large area. This combination of heavy frozen precipitation and winds can be quite destructive and lead to widespread utility failures and high cleanup costs. Nor'easters may occur from November through April, but are usually at their worst in January, February, and March.

The impacts of winter storms are minimal in terms of property damage and long-term effects. The most notable impact from winter storms is the damage to power distribution networks and utilities. Severe winter storms with significant snow accumulation have the potential to inhibit normal functions of the Middle Peninsula. Governmental costs for this type of event are a result of the needed personnel and equipment for clearing streets. Private sector losses are attributed to lost work when employees are unable to travel. Homes and

businesses suffer damage when electric service is interrupted for long periods. Health threats can become severe when frozen precipitation makes roadways and walkways very slippery and due to prolonged power outages and if fuel supplies are jeopardized. Occasionally, buildings may be damaged when snow loads exceed the design capacity of their roofs or when trees fall due to excessive ice accumulation on branches. The primary impact of excessive cold is increased potential for frostbite, and potentially death as a result of over-exposure to extreme cold. Some secondary hazards extreme/excessive cold present is a danger to livestock and pets, and frozen water pipes in homes and businesses.

Snowstorms do not occur every year in the Middle Peninsula. The West Virginia University Extension Service developed estimates the likelihood for snowfall frequency and accumulation for 152 monitoring stations across the Commonwealth based on historic snowfall accumulation and frequency data (Rayburn and Lozier 2001, these data are available on-line at: http://www.wvu.edu/~agexten/forglvst/VAsnow/index.htm). Three of these stations are located on the Middle Peninsula: Urbanna in Middlesex County, Walkerton in King and Queen County, and West Point in King William County. While the other counties of the Middle Peninsula were not included in the West Virginia University Extension Office data, these stations may be considered representative to predict annual snow cover likelihood for the rest of the Middle Peninsula.

At the Urbanna Station in Middlesex County, snow cover data was collected for 24 years between 1949 and 1973 (*Appendix 3*). Based on snowfall frequency and accumulation during this period, a general risk of snow cover and snow depth in a given year was calculated. Rayburn and Lozier determined that there is a 50% risk of having between 1 and 8 inches of snow on the ground for 8 days or more. This means that, in one year out of two, Urbanna will probably have snow of up to 8 inches on the ground for 8 days. In one year out of 4, Urbanna may have snow cover up to 8 inches deep for 12 days (in other words, there is a 25% chance of having snow for 12 days). In one year out of ten, Urbanna may have up to 8 inches of snow for 17 days (there is a 10% chance of having snow for 17 days). For deeper accumulations (greater than 8 inches), there is a 10% risk of having snow cover for 2 days or more. This means that, in 1 year out of 10, this location probably will have snow cover of at least 8 inches for 2 days.

At the Walkerton Station in King and Queen County, snow cover data was collected for 66 years between 1931 and 1997 (*Appendix 4*). Based on snowfall frequency and accumulation during this period, a general risk of snow cover and snow depth in a given year was calculated. Rayburn and Lozier determined that there is a 50% risk of having between 1 and 8 inches of snow on the ground for 6 days or more. This means that, in one year out of two, Walkerton will probably have snow of up to 8 inches on the ground for 6 days. In one year out of 4, Walkerton may have snow cover up to 8 inches deep for 13 days (in other words,

there is a 25% chance of having snow for 13 days). In one year out of ten, Walkerton may have up to 8 inches of snow for 22 days (there is a 10% chance of having snow for 22 days). For deeper accumulations (greater than 8 inches), the risk is the same as reported for Urbanna and there is a 10% risk of having snow cover for 2 days or more. This means that, in 1 year out of 10, this location probably will have snow cover of at least 8 inches for 2 days.

At the West Point station in King William County, snow cover data was collected for 44 years between 1953 and 1997 (*Appendix 5*). Based on snowfall frequency and accumulation during this period, a general risk of snow cover and snow depth in a given year was calculated. Rayburn and Lozier determined that there is a 50% risk of having between 1 and 8 inches of snow on the ground for 8 days or more. This means that, in one year out of two, West Point will probably have snow of up to 8 inches on the ground for 8 days. In one year out of 4, West Point may have snow cover up to 8 inches deep for 15 days (in other words, there is a 25% chance of having snow for 15 days). In one year out of ten, West Point may have up to 8 inches of snow for 19 days (there is a 10% chance of having snow for 19 days). For deeper accumulations (greater than 8 inches), the risk is the same as reported for both Urbanna and Walkerton. There is a 10% risk of having snow cover for 2 days or more. This means that, in 1 year out of 10, this location probably will have snow cover of at least 8 inches for 2 days.

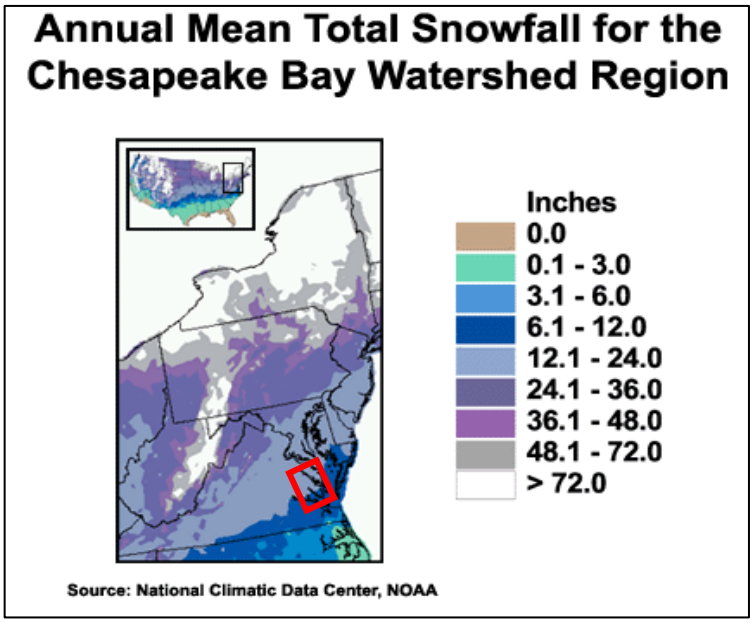


Figure 8: Map of annual mean total snowfall for the Chesapeake Bay Watershed region (StormCenter Communicatons 2003). The area encompassing the Middle Peninsula is highlighted on the map with a red square.

Compared to western, northern, and mountainous regions of the state, the risk of high snow accumulations in the Middle Peninsula is low (Figure 8). According to the National Climactic Data Center, mean annual snowfall in the Middle Peninsula ranges from between 6 and 12 inches at the lower reaches of the region (primarily in Gloucester and Mathews Counties) to as much as 12 to 24 inches in the upper reaches of the region (primarily in Essex, King and Queen, King William, and Middlesex Counties). The proximity of the water bodies

bordering the region (Chesapeake Bay and its tributaries) to the Atlantic Ocean allows the Bay to retain heat and buffer the region from intense snow. The amount of snow that falls across the watershed varies both from year to year and from location to location. Generally, areas to the north, such as in Pennsylvania and New York, see more snow in an average year than locations in the southern part of the watershed. For areas to the south, such as Norfolk, winters typically pass without a measurable amount of snowfall.

4.3.2. Riverine Flooding

A flood is partial or complete inundation of normally dry land areas. *Riverine flooding* is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt, or ice. This type of flooding is different from *coastal flooding*, which is caused by storm surge and wave action and affects coastal areas, especially those along the beachfront. There are several types of riverine floods, including headwater, backwater, interior drainage, and flash flooding. Flash flooding is characterized by rapid accumulation or runoff of surface waters from any source. This type of flooding impacts smaller rivers, creeks, and streams and can occur because of dams being breached or overtopped. Because flash floods can develop in a matter of hours, most flood-related deaths result from this type of event.

Periodic flooding of lands adjacent to non-tidal rivers and streams is a natural and inevitable occurrence. When stream flow exceeds the capacity of the normal water course, some of the above-normal stream flow spills over onto adjacent lands within the floodplain. Riverine flooding is a function of precipitation levels and water runoff volumes within the watershed of the stream or river. The recurrence interval of a flood is defined as the average time interval, in years, expected to take place between the occurrence of a flood of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

The major rivers of the Middle Peninsula are tidal in nature, serving as estuarine tributaries of the Chesapeake Bay. Flood hazard varies by location and type of flooding. Riverine flooding is more of a threat to mountainous regions, where population areas typically lie in narrow valleys, which lack the ability to store and dissipate large amounts of water. Consequently, stream flow tends to increase rapidly.

4.3.3. Wildfire

A wildfire is an uncontrolled burning of grasslands, brush, or woodlands. The potential for wildfire depends upon surface fuel characteristics, recent climate conditions, current meteorological conditions, and fire behavior. Hot, dry summers and dry vegetation increase susceptibility to fire in the fall, a particularly dangerous time of year for wildfire.

The three leading causes of wildfires in Virginia are escaped debris fires, arson, and machine use. Wildfires can also result from natural occurrences, such as lightning strikes. Wildfire danger can vary greatly season to season and is often exacerbated by dry weather conditions.

The Virginia Department of Forestry (VDOF) indicates that there are three principle factors that can lead to the formation of wildfire hazards: topography, fuel, and weather. The environmental conditions that exist during spring (March and April) and fall (October and November) exacerbate the hazard. When relative humidity is low and high winds are coupled with a dry forest floor (brush, grasses, leaf litter), wildfires may easily ignite. Years of drought can lead to environmental conditions that promote wildfires. In Virginia, accidental or intentional setting of fires by humans is the largest contributor to wildfires. Residential areas that expand into wildland areas also increase the risk of wildfire threats.

As development has spread into areas which were previously rural, new residents have been relatively unaware of the hazards posed by wildfires and have used highly flammable material for constructing buildings. This has not only increased the threat of loss of life and property, but has also resulted in a greater population of people less prepared to cope with wildfire hazards.

The impacts of wildfires can be widespread leading to many secondary hazards. During a wildfire, the removal of groundcover that serves to stabilize soil can lead to hazards such as landslides, mudslides, and flooding. In addition, the leftover scorched and barren land may take years to recover and the resulting erosion can be problematic.

Because of wild fire risk, the Virginia Department of Forestry (VDOF) has provided new information on identifying high-risk fire areas. Their Fire Risk Assessment Mapping Database was designed to help communities determine areas with the greatest vulnerability to wildfire. Since wildfire occurrence is based on some many different factors, the VDOF developed a fire ranking map to assist to wildfire prevention efforts, as shown in Figure 9. In 2002 and 2003, VDOF examined which factors influence the occurrence and advancement of wildfires and how these factors could be represented in a GIS model. VDOF determined that historical fire incidents, land cover (fuels surrogate), topographic

characteristics, population density, and distance to roads were critical variables in a wildfire risk analysis. The resulting high, medium, and low risk category reflect the results of these analyses.

FIGURE 9: Middle Peninsula Wildfire Risk

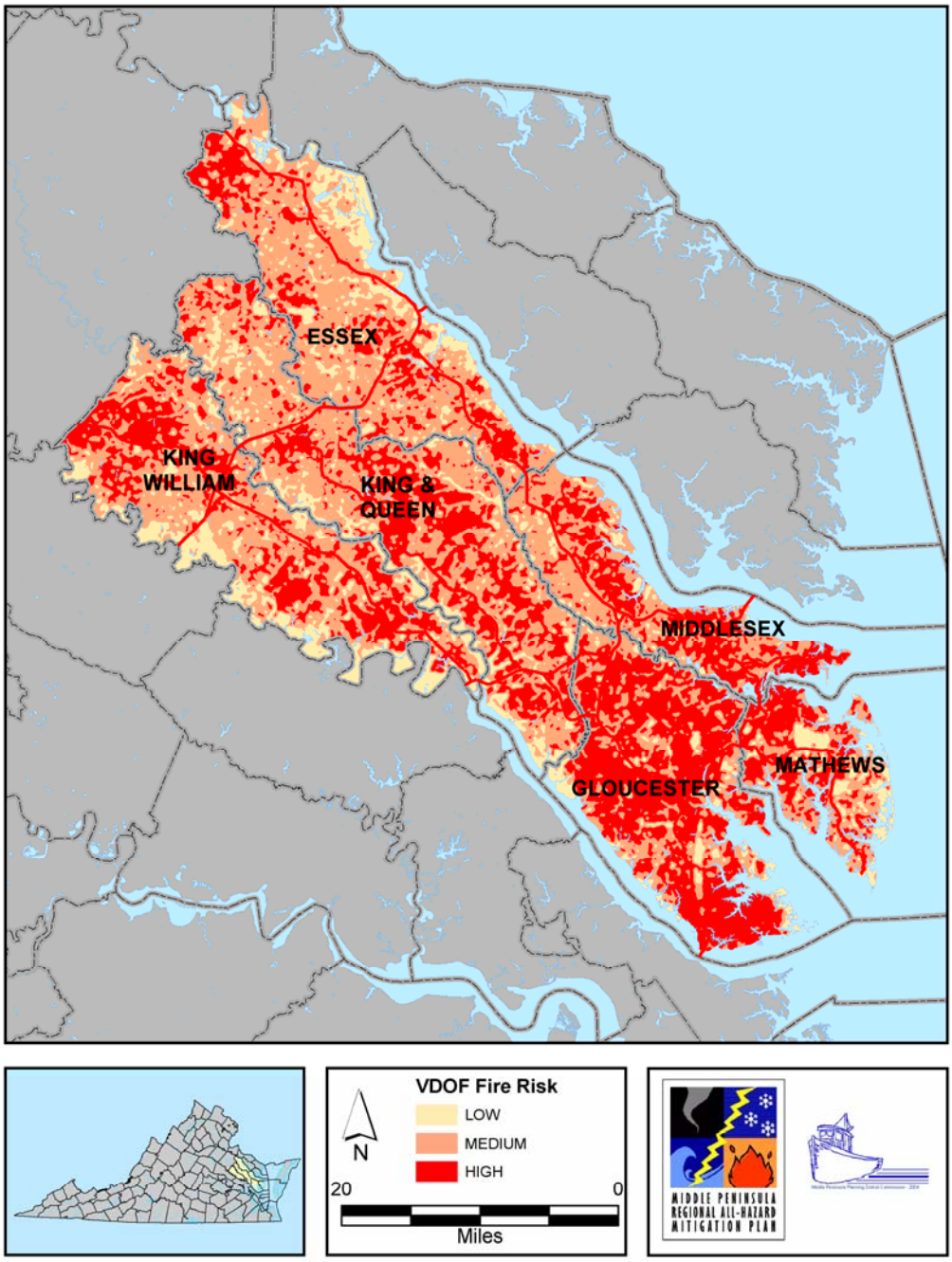


Table 3: Total area of each Middle Peninsula County within each Virginia Department of Forestry (VDOF) Fire Risk Category.

Area within each Fire Risk Category (acres)

	LOW	MEDIUM	HIGH	Total Acreage
Essex	33,894	105,885	31,999	171,778
Gloucester	16,267	46,195	90,182	152,644
King and Queen	28,569	117,897	59,440	205,906
King William	42,127	89,417	51,039	182,583
Mathews	14,903	28,819	21,966	65,688
Middlesex	8,619	50,251	33,320	92,190
Middle Peninsula Total	144,380	438,464	287,946	870,790

Table 4: Percent of each Middle Peninsula County's area within each Virginia Department of Forestry (VDOF) Fire Risk Zone.

Percent of County within each Fire Risk Category

	LOW	MEDIUM	HIGH
Essex	19.7	61.6	18.6
Gloucester	10.7	30.3	59.1
King and Queen	13.9	57.3	28.9
King William	23.1	49.0	28.0
Mathews	22.7	43.9	33.4
Middlesex	9.3	54.5	36.1
Middle Peninsula Total	16.6	50.4	33.1

As a region, most of the area making up the Middle Peninsula falls within the "Medium" Fire Risk category (Tables 3 and 4). It is noteworthy that nearly 60 percent of the area of Gloucester County falls within the "High" Fire Risk category (Table 4).

Debris burning continues to be the leading cause of forest fires in Virginia. The Commonwealth of Virginia has several laws that help to reduce the risk of wildfires. Most notably is the 'Virginia's 4:00 PM Burning Law', which goes into effect each spring. The 4:00 PM Burning Law is different from the burning bans, which are invoked only during periods of extreme fire danger. Briefly, the 4:00 PM Burning Law states: from February 15 through April 30 of each year, no burning before 4:00 PM is permitted if the fire is in, or within 300 feet of, woodland, brushland or fields containing dry grass or other flammable material.

Since forest fuels cure during the winter months, the danger of fire is higher in early spring than in summer when the forest and grasses are green with new growth. The 4:00 PM Burning Law is an effective tool in the prevention of forest fires.

Areas where homes meet the Wildland are called the Wildland/Urban interface. Flammable forest fuels often surround homes located in the woods. The Virginia Department of Forestry suggests the following safety tips to minimize the threat to homes:

- Have a least 30 feet of defensible space surrounding a home. This will reduce the wildfire threat to a home by changing the characteristics of the surround vegetation. Defensible space also allows firefighters room to put out fires.
- Build with fire-resistant exterior construction materials, such as cement, brick, plaster, and stucco and concrete masonry. Double pane glass windows can make a home more resistant to wildfire heat and flames. Roofs should be Class A.
- Use landscaping materials and design to also create defensible space. Remove flammable plants that contain resins, oils and waxes that burn readily. Large, leafy hardwood trees should be pruned so that the lowest branches are at least 6 to 10 feet high to prevent a fire on the ground from spreading up to the treetops.
- Identify a home and neighborhood with legible and clearly marked street names and numbers so emergency vehicles can rapidly find the location of the emergency. Include a driveway that is at least 12 feet wide with a vertical clearance of 15 feet – provide access to emergency apparatus.

4.3.4. High Wind / Windstorms (excluding tornados and hurricanes)

High winds and windstorms, when not a result of hurricanes or tornadoes, are often associated with thunderstorms. The National Weather Service (NWS) defines a severe thunderstorm as having winds 50 kts (58 mph) or hail greater than ¾" in diameter (about dime-sized). This strong frontal system could produce violent damaging effects to the community, such as hail, lightning, high winds (sometimes including tornadoes), and flash floods. Numerous thunderstorms occur in Middle Peninsula every year. Historically the most severe occur during the spring and summer.

The threat that any particular thunderstorm presents varies depending on its intensity, structure, and the ground below it. Many thunderstorms simply require people and their belongings to seek shelter inside a sturdy building. However, severe thunderstorms can be very dangerous and require seeking shelter underground because of the damage, they can cause to buildings. A thunderstorm is considered severe if it produces hail larger than 3/4 of an inch (2

cm), winds greater than 58 mph (93 kph), or tornadoes. In the U.S., only about 10% of all thunderstorms are classified as severe. Seeking shelter before a thunderstorm has arrived is best because high wind and lightning can form well in advance of any precipitation. Hail-resistant roofs can reduce property damage, as can properly attached roofs. As always, learning about what safety measures to take during a thunderstorm is the first and most important step in coping with thunderstorms.

In the U.S., the National Weather Service issues severe thunderstorm watches and warnings. A watch is issued when atmospheric conditions are favorable for the development of a severe thunderstorm. A warning is issued when severe thunderstorms have developed. As with tornado watches and warnings, these are broadcast via the media (radio and television), Internet, and NOAA weather radios. Particularly of note for coastal communities, such as the Middle Peninsula, are wind advisories associated with water bodies. A Small Craft Advisory is issued for sustained winds 25-33 knots and/or Seas > 7 feet within 12 hours; There is no legal definition of "small craft" but the Coast Guard generally recommends boats smaller than 33 feet should avoid being on the water, but it depends on the experience of the crew. A Gale Warning is issued for 1-minute sustained surface winds in the range 34 kt (39 mph or 63 kph) to 47 kt (54 mph or 87 kph) inclusive, either predicted or occurring not directly associated with tropical cyclones. Reliable forecasting is essential to providing communities with adequate warnings about incoming thunderstorms and the specific threats that each storm possesses.

4.3.5. Dam Failure

There are no established databases in Virginia of historical dam failures. Small, privately owned dams are located throughout the Middle Peninsula, but no database is readily available to map their locations. The Beaverdam Reservoir in the north of the Gloucester Courthouse area, contained by dam structures, covers approximately 635 acres. The reservoir is primarily surrounded by low density zoning and a 300 foot by 600 foot buffer surrounding the reservoir is owned by the county and makes up Beaverdam Park.

The Lake Anna dam near Mineral, Virginia creates an impoundment with a surface area of approximately 13,000 acres. Releases from this lake flow into the Pamunkey River, affecting the level of the river during major releases. The potential hazards of a major dam failure for King William County are flooding of lowlands and some roads and the potential loss of three bridges. There are no dwellings within the inundation area, but there are some agricultural structures that would be affected (King William County Emergency Operations Plan).

Most dam failures occur due to lack of maintenance of dam facilities in combination with excess precipitation events, such as hurricanes and

thunderstorms. During Hurricane Floyd in 1999, floods broke open at least 12 unregulated dams in eastern Virginia. One of those failures, at the Cow Creek Dam near Gloucester Courthouse, temporarily closed state Route 14; No one was hurt. Rebuilding the dam cost about $160,000 (U.S. Water News Online 2002). During Tropical Storm Gaston in late summer of 2004, a dam was overtopped in King William County and caused a washout of Route 610 between Rt. 608 and Rt. 609. The road was closed to traffic for several weeks (VDOT 2004).

Dam failure poses a risk when there are large potential areas with large populations surrounding dams. On-going dam inspections and Virginia's participation in the National Dam Safety Program maintained by FEMA and the U.S. Army Corps of Engineers serve as preventative measures against dam failures.

The Virginia Department of Conservation and Recreation, Division of Dam Safety's mission is to conserve, protect, enhance, and advocate the wise use of the Commonwealth's unique natural, historical, recreational, scenic and cultural resources. The program's purpose is to provide for safe design, construction, operation, and maintenance of dams to protect public safety. Disaster recovery programs include assistance to dam owners and local officials in assessing the condition of dams following a flood disaster and assuring the repairs and reconstruction of damaged structures are compliant with the National Flood Insurance Program (NFIP) regulations.

Failure of dams may result in a localized major impact. Impacts include loss of human life, economic loss, lifeline disruption, and environmental impact such as destruction of habitat. Secondary impacts from dam failure include flooding to the surrounding areas.

In 2001, the dam inventory mapping and classification system was changed. The classes now range in descending order from Class I to Class IV with Class I having the greatest potential for adverse downstream impacts in event of failure. This classification is not related to the physical condition of the dam or the probability of its failure. Because of the updated classification system, no data is available for the number of dams in each of the listed classes. DCR Division of Dam Safety is currently working on this.

Dams are classified with a hazard potential depending on the downstream losses estimated in event of failure. Hazard potential is not related to the structural integrity of a dam but strictly to the potential for adverse downstream effects if the dam were to fail. Frequency of dam inspection is dependent of how the dam is classified. The owner of each regulated Class I, II, and III dam is required to apply to the Soil and Water Conservation Board for an operation and maintenance certificate.

4.3.6. Drought

Empirical studies conducted over the past century have shown that drought is never the result of a single cause. It is the result of many causes, often synergistic in nature, and therefore often difficult to predict more than a month or more in advance. In fact, an area may already be in a drought before drought is even recognized. The immediate cause of drought is the predominant sinking motion of air (subsidence) that results in compressional warming or high pressure, which inhibits cloud formation and results in lower relative humidity and less precipitation. Regions under the influence of semipermanent high pressure during all or a major portion of the year are usually deserts, such as the Sahara and Kalahari deserts of Africa and the Gobi Desert of Asia. Most climatic regions experience varying degrees of dominance by high pressure, often depending on the season. Prolonged droughts occur when large-scale anomalies in atmospheric circulation patterns persist for months or seasons (or longer). The extreme drought that affected the United States and Canada during 1988 resulted from the persistence of a large-scale atmospheric circulation anomaly (National Drought Mitigation Center 2004).

Drought is a phenomenon that, in one form or another, affects the Commonwealth on nearly an annual basis. Drought has several definitions, depending upon the impact. Agricultural drought is the most common form of drought, and is characterized by unusually dry conditions during the growing season. Meteorological drought is defined as an extended period (generally 6 months or more) when precipitation is less than 75 percent of normal during that period. If coincident with the growing season, agricultural and meteorological drought can occur simultaneously. In general, hydrologic drought is the most serious, and has the most wide reaching consequences. Hydrologic drought occurs due to a protracted period of meteorological drought, which reduces stream flows to extremely low levels (“Dry years” in Figure 10), and creates major problems for public (reservoir/river) and private (well) water supplies.

Extended periods of drought can impact crop yields and hay yields, and significant crop losses can result. The impact of meteorological drought can vary significantly, depending upon

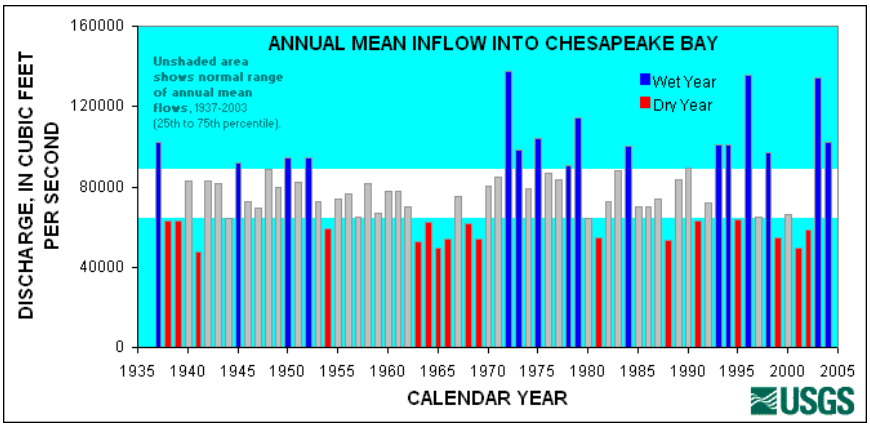


Figure 10: Annual mean stream inflow into Chesapeake Bay 1937 – 2003. (Figure courtesy of USGS). Dry years indicated by red bars

the length of the dry period, the time of year the dry period occurs, the antecedent moisture conditions prior to the onset of the dry period, and the relative dryness (in percent of normal precipitation) of the period in question. Drought duration is highly variable by region. The duration also depends on when the precipitation is needed for such activities as planting and irrigation.

Table 5 provides a summary of drought categories and impacts. Notice that water restrictions start as voluntary and then become required.

Table 5: Drought Severity Classification

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

There have been five major statewide droughts since the early 1900's (USGS 2002). The drought of 1930-32 was one of the most severe droughts recorded in

the State. The droughts of 1938-42 and 1962-71 were less severe; however, the cumulative stream flow deficit for the 1962-71 drought was the greatest of the droughts because of its duration. The drought of 1980-82 was the least severe and had the shortest duration. Tidewater Virginia experienced “Severe Drought” conditions during the drought of 2001-2002 when stream flow into Chesapeake Bay was only half the average annual flow into the Bay (Virginia State Climatology Office, 2002).

Virginia is one of 37 states that have implemented a Drought Plan. The goals of these plans are to reduce water shortage impacts, personal hardships, and conflicts between water and other natural resource users. These plans promote self-reliance by systematically addressing issues of principal concern. The National Drought Policy Commission’s report to Congress and the president, “Preparing for Drought in the 21st Century” (available on-line at: http://www.fsa.usda.gov/drought/finalreport/fullreport/pdf/reportfull.pdf), emphasizes the need for drought planning at the state, local, federal, and tribal levels of government. Virginia’s Plan emphasizes response strategies.

4.4. *Hazards considered "Critical Hazards" to the Middle Peninsula:*

The following sections describe natural hazards that are common throughout the Middle Peninsula region and deemed "Critical Hazards" to the Middle Peninsula by the RAMP Committee: Hurricanes (including Coastal Storms), Winter Ice Storms, Tornadoes, and Coastal Flooding. A section describing specific vulnerabilities within each Middle Peninsula Locality follows the description of each of these hazard types.

4.4.1. Hurricanes (and Coastal Storms)

Hurricanes are cyclonic storms that originate in tropical ocean waters. Most hurricanes develop in an area 300 miles wide on either side of the equator. Hurricanes are heat engines, fueled by the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, sufficiently 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.

Hurricanes that impact Virginia form in the so-called Atlantic Basin, from the west coast of Africa westward into the Caribbean Sea and Gulf of Mexico. Hurricanes in this basin generally form between June 1 and November 30, with a peak around mid-September. In an average season, there are about ten named tropical storms in the Atlantic with six of these likely to develop into a hurricane. The busiest hurricane season of the 20th century was 1933, which saw 21 hurricanes and tropical storms, two of which hit the tidewater region and caused much devastation on the Middle Peninsula (known as the "Chesapeake-Potomac Hurricanes of 1933"). The 1914 season saw no hurricanes and only one tropical storm.

As an incipient hurricane develops, barometric pressure at its center falls and winds increase. A weather system with winds at or exceeding 39 mph is designated as a tropical storm, which is given a name and closely monitored by the NOAA National Hurricane Center in Miami, Florida. When winds are at or exceed 74 mph, the tropical storm is deemed to be a hurricane. Hurricane intensity is measured using the Saffir-Simpson Scale, ranging from one (1) (minimal) to five (5) (catastrophic) (Table 4). The scale categorizes hurricane intensity linearly based upon maximum sustained winds, minimum barometric pressure and storm surge potential, which are combined to estimate of the potential flooding and damage to property given a hurricane's estimated intensity.

Hurricanes have the greatest potential to inflict damage as they cross the coastline from the ocean, which is called landfall. Because hurricanes derive their strength from warm ocean waters, they are generally subject to deterioration once they make landfall. The forward momentum of a hurricane can vary from just a few miles per hour to up to 40 mph. This forward motion, combined with a

counterclockwise surface flow make the right front quadrant of the hurricane the location of the most potentially damaging winds.

Hurricanes have the potential to spawn dangerous tornadoes. The excessive rainfall and strong winds can also cause flash floods, flooding and abnormal rises in sea levels. Although a hurricane may cause a tremendous amount of wind and water damage, the accompanying storm surge is much more dangerous to life and property in coastal regions. The storm surge is a great dome of water typically 50 miles wide that comes sweeping across the coastline near the area where the eye of the hurricane makes landfall. This storm surge, aided by the hammering effect of breaking waves, acts like a giant bulldozer, sweeping everything in its path. The stronger the hurricane, the higher and more dangerous the storm surge will be. Nine out of ten hurricane fatalities are caused by the storm surge.

Coastal high water is generally attributed to three causes: Astronomical high tides, high water from atmospheric events (such as surface run off from rain), and storm surge (from hurricanes and nor'easters). Astronomical high tides alone do not cause dangerous coastal erosion, but when these tides occur in tandem with a storm surge or onshore winds, coastal flooding and erosion may be intensified.

Hurricane Isabel was one of Virginia's costliest disasters, causing widespread devastation and disrupting the lives of thousands of citizens. This deadly storm was a Category 2 hurricane (Table 6) when it made landfall between Cape Lookout and Cape Hatteras on North Carolina's Outer Banks on Thursday, September 18, 2003. By the time it reached Virginia, it was downgraded to a Category 1. Even though the storm followed a path west of Richmond, Isabel's destructive effects were felt throughout Tidewater Virginia and the entire Mid-Atlantic region. Hampton Roads remained in the right front quadrant through most of the storm's landfall, which helped to push the storm surge into many areas inland along the rivers. Property damage resulting from the four to twelve-foot storm surge was extensive in many parts of the region. Homes, bulkheads and piers were damaged and the winds resulted in significant damage to properties and power lines. Rainfall totaled between 2 to 11 inches along the storm's track. Trees, especially those with shallow root systems, were blown over. Damages due to wind, rain, and storm surge resulted in flooding, electrical outages, debris, transportation interruption, and damaged homes and businesses. Many citizens were without power for several days and power was not restored in some remote locations for three weeks. Statewide losses to residential property were estimated to exceed $590 million and businesses reported over $84 million in losses. Thirty-two deaths were directly or indirectly attributed to this storm in Virginia. One of these deaths was in Gloucester County when an individual died of a heart attack after their vehicle was swept up in high water. Isabel is considered one of the most significant tropical cyclones to affect portions of northeastern North Carolina and east-central Virginia since

Table 6: Saffir-Simpson Hurricane Damage Scale

All Hurricanes are dangerous, but some are more so than others. The way storm surge, wind, and other factors combine determine the hurricanes destructive power. To make comparisons easier and to make the predicted hazards of approaching hurricanes clearer to emergency managers, National Oceanic and Atmospheric Administration's hurricane forecasters use a disaster-potential scale that assigns storms to five categories. This can be used to give an estimate of the potential property damage and flooding expected along the coast with a hurricane.

The scale was formulated in 1969 by Herbert Saffir, a consulting engineer, and Dr. Bob Simpson, director of the National Hurricane Center. The World Meteorological Organization was preparing a report on structural damage to dwellings due to windstorms, and Dr. Simpson added information about storm surge heights that accompany hurricanes in each category.

Hurricane Category	Sustained Winds (mph)	Damage Potential
1	74 - 95	Minimal
2	96 - 110	Moderate
3	111 - 130	Extensive
4	131 - 155	Extreme
5	> 155	Catastrophic

Category 1
A Category 1 hurricane poses minimal damage to unanchored mobile homes along with shrubbery and trees. There may be pier damage and coastal road flooding, with storm surge 4-5 feet about average.

Category 2
Category 2 hurricanes have a moderate damage potential to mobile homes and piers, as well as significant damage to shrubbery and tress with some damages to roofs, doors and windows. Impacts include flooding 2-4 hours before arrival of the hurricane in coastal and low lying areas. Storm surge can be 6-8 feet above average.

Category 3
Category 3 hurricanes have an extensive damage potential. There will be structural damage to small residences and utility buildings. Extensive damage is to mobile homes, trees, and shrubbery. Impacts include flooding 3-5 hours before the arrival of the hurricane cutting off the low-lying escape routes. Coastal flooding has the potential to destroy the small structures, with significant damage to larger structures because of the floating debris. Land that is lower than 5 feet below mean sea level can be flooded 8 or more miles inland. Storm surge can be 6-12 feet above average.

Category 4
Category 4 hurricanes have extreme damage potential. Structures may experience extensive curtainwall failures with extensive damage to doors and windows and some complete roof structure failure on small residences. Major damage will occur to lower floors of structures near the shore. Complete destruction of mobile homes is likely. Shrubs, trees, and all signs are blown down and beaches experience major erosion. Low-lying escape routes may be cut by rising water 3-5 hours before arrival of the hurricane center. Terrain lower than 10 feet above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles.

Table 6: Saffir-Simpson Hurricane Damage Scale (continued)

Category 5
Category 5 hurricanes cause catastrophic damages. Complete roof failure on many residences and industrial buildings can occur. Severe and extensive window and door damage is expected. Some complete building failures with small utility buildings may be blown over or away. All shrubs, trees, and signs may be blown down. Complete destruction of mobile homes is likely.. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the hurricane center. Major damage to lower floors of all structures located less than 15 ft (5.1 m) above sea level and within 500 yards (455 m) of the shoreline is likely. Massive evacuation of residential areas on low ground within 5-10 miles (8-16 km) of the shoreline may be required.

Hurricane Hazel in 1954 and the Chesapeake-Potomac Hurricane of 1933 (Beven and Cobb 2004).

Although Virginia was spared a direct hit, the hurricane season of 2004 may be the costliest on record for the United States. Fifteen tropical or subtropical storms formed in the North Atlantic. Nine of these storms became hurricanes with six becoming major hurricanes of category three or higher on the Saffir-Simpson Hurricane Scale (Table 6). Six of the hurricanes, Alex, Charley, Frances, Gaston, Ivan, and Jeanne, and three tropical storms struck the United States in 2004. The strongest hurricane was Ivan, which reached category five status. Ivan is directly blamed for 26 deaths in the United States and damage in the United States is estimated to be $13 billion. With four hurricanes and tropical storms hitting the United States in a five-week period, 2004 has been labeled as the year of the hurricane and, according to leading experts who participated in a Center for Health and the Global Environment briefing at Harvard Medical School (Compass Publications, Inc. 2004). They report that the intense period of destructive weather may be a harbinger of what is to come. Hurricanes have been on the increase over the past decade as part of a natural multi-decadal cycle (Ananthaswamy 2003). These storms are more likely to form when the Atlantic is warm, as it was in the 1930s to 1960s. The decades since the 1960s saw fewer hurricanes, but numbers have risen since 1995 and may not have reached the predicted peak yet. While experts cannot say that climate change will result in more hurricanes in the future, there is growing evidence and concern that tropical storms that do occur will be more intense than those in the past as the effects of global warming become even more pronounced in future years.

By virtue of its position along the Atlantic Ocean and near the Gulf Stream, southeastern Virginia is frequently impacted by hurricanes. Continuous weather records for the Hampton Roads Area of Virginia began on January 1, 1871 when the National Weather Service was established in downtown Norfolk. The recorded history of significant tropical storms that affected the area goes back

much further. Prior to 1871, very early storms have been located in ship logs, newspaper accounts, history books, and countless other writings. The residents of coastal Virginia during Colonial times were very much aware of the weather. They were a people that lived near the water and largely derived their livelihood from the sea. To them, a tropical storm was indeed a noteworthy event. The excellent records left by some of Virginia's early settlers and from official records of the National Weather Service are summarized in the "*Chronology of Middle Peninsula Hazard Events*" section that follows.

Since 1953, Atlantic tropical storms have been named from lists originated by the National Hurricane Center. The lists featured only women's names until 1979 when male and female names were included in lists for the Atlantic and Gulf of Mexico. Whenever a hurricane has had a major impact, any country affected by the storm can request that the name of the hurricane be "retired" by agreement of the World Meteorological Organization (WMO). Retiring a name actually means that it cannot be reused for at least 10 years, to facilitate historic references, legal actions, insurance claim activities, etc. and avoid public confusion with another storm of the same name. Retired names for storms that hit the Tidewater region include Agnes (1972), Cleo (1964), David (1979), Donna (1960), Floyd (1999), Fran (1996), Gloria (1985), Gracie (1959), Hazel (1954), and Isabel (2003) (NOAA Atlantic Oceanographic and Meteorological Laboratory, Hurricane Research Division).

In order to estimate the extent of potential damage from these storms, hurricane storm surge maps were developed to reflect a worst case scenario of hurricane storm surge inundation at mean tide. The data reflects only still water salt water flooding. Freshwater flooding may also occur with the hurricane event from heavy rainfall runoff, and waves may accompany the surge and cause further inundation. The maps represent the surge from hurricane category strengths 1 through 4.

The maps summarize surge height estimates using the SLOSH (Sea, Lake, and Overland Surges from Hurricane) model. The model was developed by Chester Jelesnianski of the National Oceanic and Atmospheric Administration, National Weather Service. The storm surge computations and analysis were conducted by the Storm Surge Group of the National Hurricane Center.

The SLOSH model was used to develop data for various combination of hurricane strength, wind speed, and direction of movement. Hurricane strength was modeled by use of central pressure (defined as the difference between the ambient sea level pressure and the minimum value in the storm's center), the storm eye size, and the radius of maximum winds (using four of the five categories of each hurricane intensity as depicted in the Saffir-Simpson Hurricane Scale, Table 6). The modeling for each hurricane category was done using the mid-range wind speed for that category. Six storm track headings (WNW, NW, NNW, N, NNE, NE) were selected as being representative of storm

behavior in the Virginia region, based on observation by forecasters at the National Hurricane Center. Additional inputs into the model included depths of water offshore, and the heights of the terrain and barriers onshore.

Historical Occurrences:

In evaluating localized threat of hurricanes and tropical storms to the Middle Peninsula region, NOAA hurricane track data from 1851 to 2003 was analyzed to identify storms that may have posed a threat to the region. Using the zip code queries of the database, historic storm tracks that passed within a chosen distance of five post offices at the northern, southern, eastern, and western extremities of the region (Gloucester Point, West Point, Urbanna, Caret, Aylett) were tallied (Figure 11). Based on these data, 35 storms, including hurricanes, tropical storms, and tropical depressions, passed within 25 nautical miles of the Middle Peninsula region (Table 7). Of these storms, two were hurricanes, 20 were tropical storms, five were tropical depressions, and eight were extratropical depressions.

Over the same period, 53 storms passed within 50 nautical miles of the region. Four of these storms were hurricanes, 29 were tropical storms, eight were tropical and subtropical depressions, and twelve were extratropical depressions (Table 7).

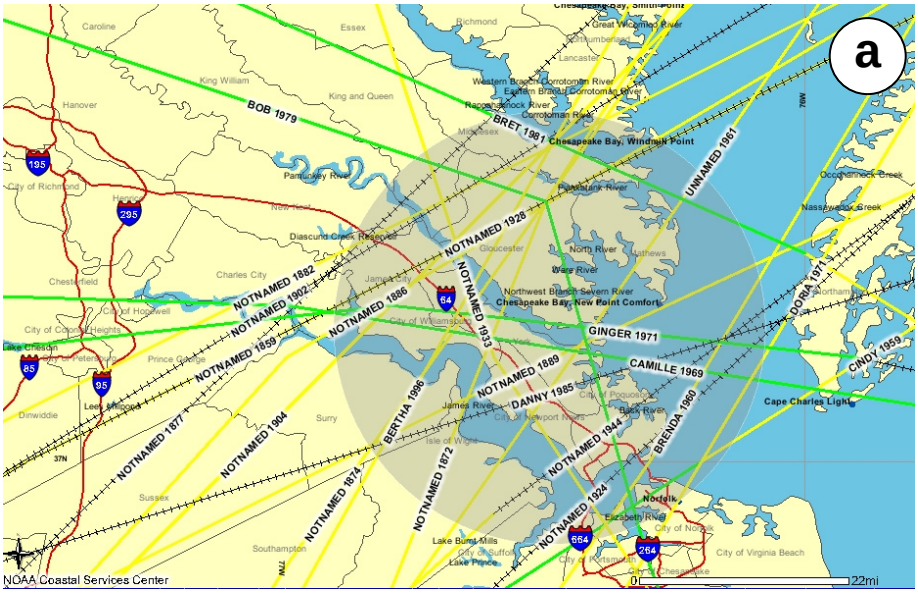
Table 7: Historic storm tracks within a 50 and 25 nautical mile radius of the Middle Peninsula, 1851-2003.

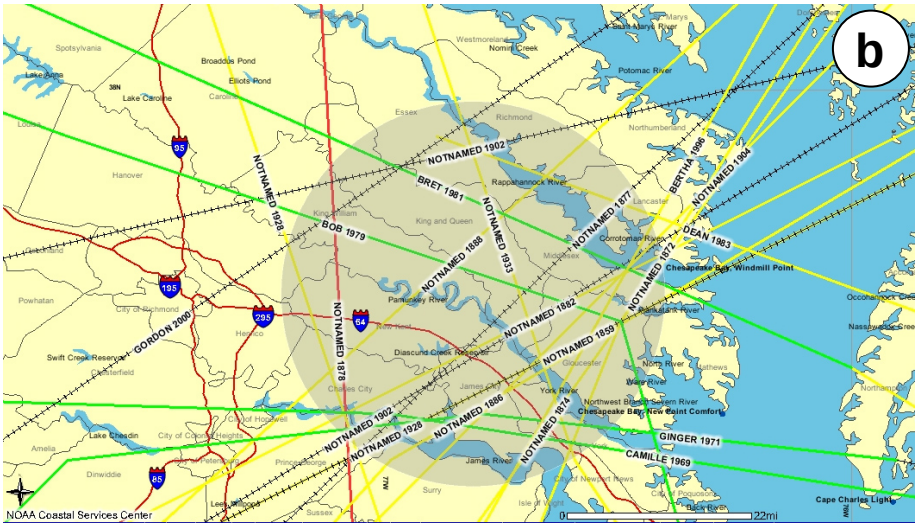
Type of Storm	Quantity passing within 50 nm	Quantity passing within 25 nm
Hurricane – Category 5 (winds >155 mph)	0	0
Hurricane – Category 4 (winds 131-155 mph)	0	0
Hurricane – Category 3 (winds 111-130 mph)	0	0
Hurricane – Category 2 (winds 96-110 mph)	1	1
Hurricane – Category 1 (winds 74-95 mph)	3	1
Tropical Storm (winds 39-73 mph)	29	20
Tropical Depression (winds <38 mph)	7	5
Subtropical Storm (winds 39-73 mph)	0	0
Subtropical Depression (winds <38 mph)	1	0
Extratropical Storm (winds <39 mph)	12	8
Total:	**53**	**35**

Figure 11: Hurricane and Tropical Storm tracks (1851-2003) passing within 25 nautical miles of (a) Gloucester Point (lower Gloucester County), (b) West Point (lower King William County), (c) Urbanna (middle Middlesex County), (d) Caret (upper Essex County), and (e) Aylett (upper King William County). Images generated by the NOAA Coastal Services Center Historical Hurricane Tracking Tool.

Legend:

- Hurricane
- Tropical Storm
- Tropical Depression
- Extratropical Storm





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UNNAMED 1961
CAMILLE 1969
GINGER 1971
Chesapeake Bay, Windmill Point
Chesapeake Bay, New Point Comfort
NOAA Coastal Services Center
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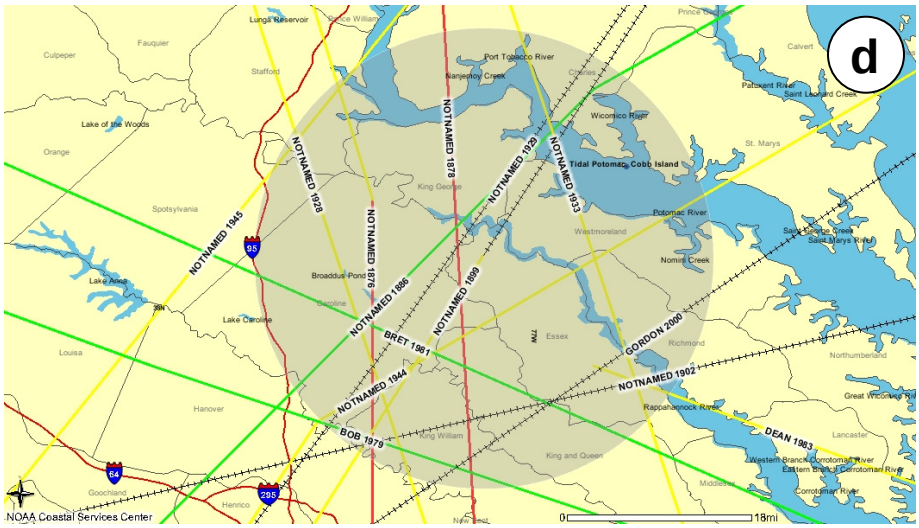
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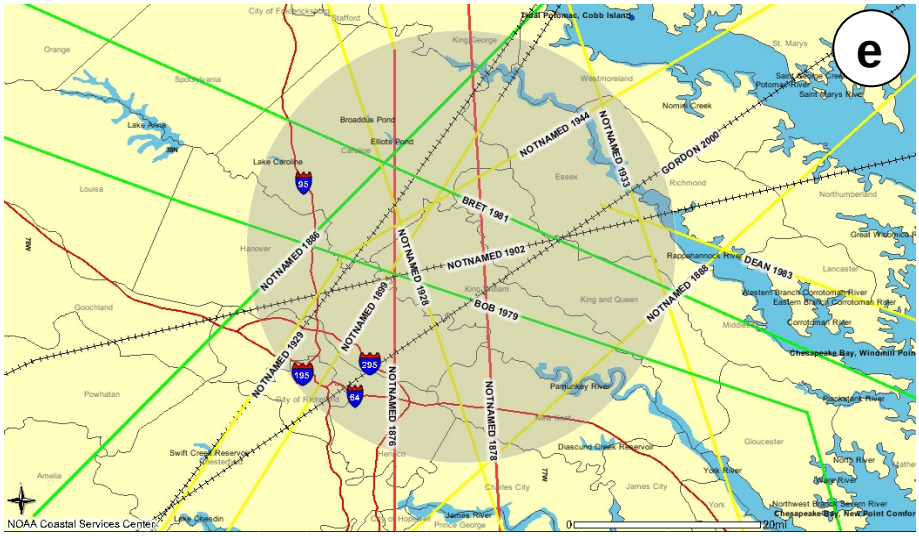
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Tidal Potomac, Cobb Island
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Chesapeake Bay, Windmill Point
Chesapeake Bay, New Point Comfort
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General Chronology of Middle Peninsula Coastal Storm Hazard Events

Because of its proximity to the Atlantic coast and Chesapeake Bay, the Middle Peninsula has been impacted by coastal storms throughout recorded history, and therefore it is not surprising that Hurricanes, Coastal Flooding, Nor'easters, and Coastal / Shoreline Erosion were among the top ranked hazards affecting the Middle Peninsula region by the Regional Risk Assessment and Mitigation Planning Committee. Hurricanes come close enough to produce hurricane force winds approximately three times every 20 years. Two or three times a century winds and tides produce considerable damage and significantly threaten life. Historical records are invaluable to researchers trying to understand long-term patterns in the frequency and intensity of coastal storms and such data on storms and weather go back a long time in Virginia, thanks to record keeping by early weather observers such as George Washington, James Madison and Thomas Jefferson, and journals and articles written by early settlers. Here we present a brief synopsis of the major coastal storm events that have impacted this region.

1564-1799:
Hurricanes played an important role during the European exploration and colonization of the Americas. Great storms that besieged Virginia influenced the establishment of new settlements and changed the coastal geography, particularly on the Middle Peninsula. While official weather records did not begin until 1871 in Norfolk, tremendous coastal storms were often recorded through the shipwrecks they induced and in writings of the early Virginia colonists. The records of hurricane and tropical storm occurrences in this era is sparse compared to modern-day accounts, since the colonies were not settled until the early 1600's. The original settlers at Jamestown experienced the wrath of such storms firsthand and it is suggested that the lost colony of Roanoke Island may have been doomed by a coastal storm. The first such storm to be recorded occurred in 1564. Others followed in June 1566, June 1586, August 1587, and August 1591. A September 1667 storm, deemed the "Dreadful Hurry Cane of 1667", destroyed thousands of homes in Virginia (Brinkley 1999). Twelve days of rain was said to have followed this storm, causing the Chesapeake Bay to rise 12 feet. This storm and a July 1788 hurricane may have followed a similar track to the 1933 hurricane, which caused massive devastation to the Middle Peninsula.

The October Hurricane of 1749 was a great disaster for Virginians. It formed Willoughby Spit in Norfolk and put the city streets of Hampton four feet below water. The Bay was said to have risen 15 feet above normal, destroying waterfront buildings (Ludlum 1963). At least 50 vessels were driven ashore along the Virginia coast, with a loss of 22 lives. Damage in and around the city of Norfolk was estimated to be at least 30,000 Virginia Pounds (approximately $3 million today) (Brinkley 1999).

The September 8, 1769 hurricane, considered one of the worst storms of the eighteenth century, passed over Williamsburg. Damage was "inconceivable" and crops were destroyed. Many old homes and trees were leveled. Heavy rain ruined tobacco crops and flooded roads. Tobacco in storage was also damaged at the warehouse. Heavy damage was seen in Chesapeake Bay. High winds tore off the top of a wharf at Yorktown; a schooner rammed a nearby storehouse. Four ships in the York River were driven ashore. Two ships on the James River were also wrecked. A vessel from Norfolk, filled with coal from Williamsburg, was forced up to Jamestown before it went to pieces (Roth and Cobb 2001).

“The Independence Hurricane” of September 1775: ravaged the coast between Currituck, N.C. and Chincoteague on the Eastern Shore. Wharves and storehouses on the waterfront of Norfolk were devastated. Raging waters carried bridges away. At Williamsburg, milldams broke and corn stalks were blown flat. Many ships were damaged as they were thrown ashore at Norfolk, Hampton, and York. A full blockade of Hampton Roads thereafter brought shipping to a halt for three months. At least twenty-five died due to shipwreck. On September 9, 1775, a Williamsburg correspondent of the Virginia Gazette wrote "The shocking accounts of damage done by the rains last week are numerous; most of the mill-dams are broke, the corn laid almost level with the ground, and fodder destroyed; many ships and other vessels drove ashore and damaged at Norfolk, Hampton, and York. The death toll in Virginia and North Carolina was 163 lives (Roth and Cobb 2001).

A strong gale played a role in a battle between the Royal Governor of Virginia, Dunmore, and General Lewis of the rebel forces on July 10, 1776. The royal fleet had been injured prior to the storm by General Lewis' forces and was sailing from Gwynn's Island (Mathews County) toward St. George's Island, in the Potomac. The British crew was without water and enduring smallpox when the gale struck. A flour-laden supply ship ran aground. One ship foundered at the Mouth of the Rappahannock, while another was stranded on the Eastern shore (Roth and Cobb 2001).

On October 16, 1781, a storm of "unknown character" struck Virginia. The French Fleet and the Patriot Army, under the command of George Washington, trapped the Earl of Cornwallis at Yorktown. The Earl decided to flee to the north to Gloucester Point under the cover of darkness. A "furious storm" doomed the plan to failure, as seas ran high and every boat was "swamped". He sent forward his flag of truce and surrendered, thus ending the battle (Roth and Cobb 2001).

The "most tremendous gale of wind known in this country" passed over the Lower Chesapeake Bay September 22-24, 1785 and went along a track very similar to the Chesapeake-Potomac Hurricane of 1933 and likely severely impacted the Middle Peninsula. At Norfolk, lower stories of dwellings were flooded. Warehouses were totally carried away by the storm surge, causing

large amounts of salt, sugar, corn, and lumber to disappear. A large number of cattle drowned, and people hung onto trees for dear life during the tempest. Vessels floated inland into cornfields and wooded areas (Roth and Cobb 2001).

“George Washington's Hurricane” of July 23-24, 1788, made landfall in Virginia and passed directly over the Lower Chesapeake Bay and Mount Vernon, the home of George Washington. This track is very similar to the track of the Chesapeake-Potomac hurricane of 1933. At Norfolk, winds increased at 5 p.m. on the 23rd with the wind originating from the northeast. At 12:30 a.m., the wind suddenly shifted to the south and "blew a perfect hurricane, tearing down chimneys, fences" and leveling corn. In addition, large trees were uprooted and houses were moved from their foundations. Port Royal (Caroline County) and Hobb's Hole (Essex County) experienced a violent northeast gale, which drove several vessels ashore. In Fredericksburg, great quantities of corn, tobacco, and fruit were destroyed. Houses and trees fell in great numbers across Northumberland, Lancaster, Richmond, and Westmoreland counties on the Northern Neck. Crops were destroyed and many livestock perished in Lower Mathews County. Many plantations saw their houses leveled. Homes were flooded with water six feet deep and several inhabitants drowned. Gloucester County was inundated, and an estimated $400,000 (in 1788 dollars) in damage was incurred (Roth and Cobb 2001).

1800-1899:

Great Coastal Hurricane of 1806 (August 23) caught British and French ships off guard, while engaged in the Napoleanic Wars in the U.S. shipping lanes. The British man-of-war *L'Impeteax* drifted under jury masts for 23 days before finally beaching near Cape Henry. Ships of the two warring nations put in for repair and refitting at the port of Norfolk after the storm. This hurricane, due to its slow movement and consequent erosion of the coastline completed the creation of Willoughby Spit at Hampton Roads. A seawall built to prevent further erosion at Smith Point lighthouse at the mouth of the Potomac River was damaged (Roth and Cobb 2001).

A severe coastal storm dropped heavy rains on the Fredericksburg area in January 1863. It rained for 30 hours, dropping more than two inches, making mud so deep that mules and horses died attempting to move equipment. The rivers became too high and swift to cross, disrupting the Union Army offensive operation in the ill-famed "Mud March" (Watson and Sammler 2004).

The Gale of '78 was one of the most severe hurricanes to affect eastern Virginia in the latter half of the 19th century and struck on October 23, 1878. This hurricane moved rapidly northward from the Bahamas on October 22nd and struck the North Carolina coast late that same day moving at a forward speed of 40 to 50 mph. The storm continued northward passing through east central Virginia, Maryland, and eastern Pennsylvania. Cobb and Smith Islands on the

Eastern Shore were completely submerged during this storm (Roth and Cobb 2001).

A September 1882 tropical storm, the "protracted and destructive rain storm" swept away four mills near Ware's Wharf along the Lower Rappahannock. The brunt of the cyclone only extended fifty miles inland. Heavy rains were also seen at Washington, D.C. (Roth and Cobb 2001).

An April 1889 Nor'easter the Tidewater region with sustained winds from the north of 75 mph measured at Hampton Roads and 105 mph at Cape Henry. Tides at Norfolk reached 8.37 feet above Mean Low Water, which is over 4 feet above flood stage level (Watson and Sammler 2004).

Noteworthy hurricanes or tropical storms also occurred in September 1821 (one of the most violent on record for the 19th century), June 1825, August 1837, September 1846 (which formed Hatteras and Oregon Inlets in North Carolina), August 1850, September 1856, September 1876, August 1879, October 1887, August 1893, September 1894, October 1897 (tides in Norfolk rose 8.1 feet above Mean Lower Low Water), and October 1899 (tide in Norfolk rose 8.9 feet above Mean Lower Low Water).

1900-1999:

A number of coastal storms hit the Tidewater region in the early part of the 20th century. Hurricanes and tropical storms in October 1903, August 1924, September 1924, August 1926, and September 1928 each brought high winds (in excess of 70 mph measured in Norfolk and Cape Henry). The 1903 and 1928 storms also raised tides as much as 9 feet and 7 feet, respectively, higher than normal in the region (Roth and Cobb 2001).

The summer of 1933 was the most active storm season for eastern Virginia in the 20th century. Two hurricanes, one on August 23 and one on September 16, struck the North Carolina and Virginia coasts and caused much devastation on the Middle Peninsula. In Chesapeake lore, the “Storm of ‘33” is recalled by older residents and enshrined in legend as the worst storm in memory (Mountford 2003). The August storm brought winds in excess of 80 mph and a storm surge that forced the tide nearly 10 feet above normal. The September storm struck the area 24 days later and had sustained winds as high as 88 mph (measured at the Naval Air Station in Norfolk) and the tide reached 8.3 feet above Mean Lower Low Water (Roth and Cobb 2001). Much of the land around the New Point Comfort lighthouse, the third oldest light on the Bay located at the entrance to Mobjack Bay and the mouth of the York River in Mathews County, was washed away causing it to be stranded on a very small island a few 100 yards from the tip of the mainland.

Hurricane Hazel hit eastern Virginia on October 15, 1954. This storm brought with it gusts of 100 mph which is the highest wind speed of record for the Norfolk Airport location. A reliable instrument in Hampton recorded 130 mph (Roth and Cobb 2001).

A severe Nor'easter gave gale winds (40 mph +) and unusually high tides to the Tidewater Virginia area on April 11, 1956. At Norfolk, the strongest gust was 70 mph. The strong northeast winds blew for almost 30 hours and pushed up the tide, which reached 4.6 feet above normal in Hampton Roads. Thousands of homes were flooded by the wind-driven high water and damages were large. Two ships were driven aground. Waterfront fires were fanned by the high winds. The flooded streets made access to firefighters very difficult, which added to the losses (Watson and Sammler 2004).

The "Ash Wednesday Storm" hit Virginia during "Spring Tide" (sun and moon phase to produce a higher than normal tide) on March 5-9, 1962. The storm moved north off the coast past Virginia Beach and then reversed its course moving again to the south and bringing with it higher tides and higher waves which battered the coast for several days. The storm's center was 500 miles off the Virginia Capes when water reached nine feet at Norfolk and 7 feet on the coast. Huge waves toppled houses into the ocean and broke through Virginia Beach's concrete boardwalk and sea wall. Houses on the Middle Peninsula also saw extensive tidal flooding and wave damage. The beaches and shorefront had severe erosion (Watson and Sammler 2004).

Hurricane Cleo in September 1964 produced the heaviest coastal rainfall in the area (11.40 inches in 24 hours) since records began in 1871 (Roth and Cobb 2001).

Hurricane Agnes was downgraded to a tropical depression by the time it moved into Virginia in June 1972, but the rainfall produced by Agnes made this storm more than twice as destructive as any previous hurricane in the history of the United States (Roth and Cobb 2001).

In July 1996, Hurricane Bertha passed over portions- of Suffolk and Newport News. Bertha spawned 4 tornadoes across east-central Virginia. The strongest, an F1 tornado, moved over Northumberland county injuring 9 persons and causing damages of several million dollars. Other tornadoes moved over Smithfield, Gloucester and Hampton (Roth and Cobb 2001).

Hurricane Floyd in September 1999 produced 10-20" of rain on saturated ground and resulted in 500 year flood of record for Franklin, VA. While North Carolina and Southeastern Virginia were hit with the brunt of this storm, significant damage from downed trees and localized flooding occurred and all of the counties of the Middle Peninsula were included in the Federal Disaster Declaration (FEMA FEMA-1293-DR, Virginia).

Hurricane Isabel hit the coasts of North Carolina and Virginia on September 18, 2003. It was a Category 1 hurricane when it made landfall. The highest sustained wind was 72 mph at Chesapeake Light. Storm surge varied significantly across the region. At Sewell's Point in Norfolk, the maximum water level was 7.9 feet above MLLW. This represents a 5-foot storm surge, the biggest in the region since Hazel in 1954. Thirty six deaths were attributed to Isabel in Virginia, including one in Gloucester. Total damages for the Hampton Roads area amounted to $506 million.

4.4.2. Coastal Flooding

Flooding is the most frequent and costly natural hazard in the United States besides fire. Nearly 90 percent of presidential disaster declarations result from natural events in which flooding was a major component. Excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto adjacent floodplains— lowlands adjacent to rivers, lakes, and oceans that are subject to recurring floods (FEMA 2002).

Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall. These conditions are produced by hurricanes during the summer and fall, and nor'easters and other large coastal storms during the winter and spring. Storm surges may overrun barrier islands and push sea water up coastal rivers and inlets, blocking the downstream flow of inland runoff. Thousands of acres of crops and forest lands may be inundated by both saltwater and freshwater. Escape routes, particularly from barrier islands, may be cut off quickly, stranding residents in flooded areas and hampering rescue efforts. Coastal flooding is very dangerous and causes the most severe damage where large waves are driven inland by the wind. These wind driven waves destroy houses, wash away protective dunes, and erode the soil so the ground level is lowered several feet. Because of the coastal nature of the Middle Peninsula, the region is very susceptible to this type of flooding.

While many floodplain boundaries are mapped by FEMA's National Flood Insurance Program (NFIP), floods sometimes go beyond the mapped floodplains or change courses due to natural processes (e.g., accretion, erosion, sedimentation, etc.) or human development (e.g., filling in floodplain or floodway areas, increased imperviousness within the watershed from new development, or debris blockage including cars, trailers, and propane tanks).

Since the floodplains in the United States are home to over nine million households, most property damage results from inundation by sediment and debris-filled water. Flooding is one of the most significant hazards faced by the Middle Peninsula. A majority of the flooding that affects the region is tidal flooding, which primarily occurs in conjunction with coastal storms such as hurricanes or nor'easters. In addition to tidal flooding, some regions of the Middle Peninsula are subject to flooding events induced by the rain associated

with a hurricane or tropical storm and which can produce extreme amounts of rainfall in short time periods. Most recently in August 2004, Tropical Storm Gaston dumped 14 inches of rain in a matter of hours on King William County, washing out numerous roads and bridges, and qualifying the county for disaster aid through a federal disaster declaration.

Flooding of vacant land or land that does not have a direct effect on people or the economy is generally not considered a problem. Flood problems arise when floodwaters cover developed areas, locations of economic importance, infrastructure, and any other critical facility. Low-lying land areas of Essex, Gloucester, Mathews, and Middlesex Counties and the lower reaches of King and Queen and King William Counties are highly susceptible to flooding, primarily from coastal storm surges. These flood-prone regions include marsh areas adjacent to waterways, and the wide, flat outlets where its streams and rivers meet the Chesapeake Bay and its tributaries. Fluctuations in the surrounding water levels produce a mean tidal range of approximately 2.4 feet. The timing or coincidence of maximum surge-producing forces with the normal high tide is an important factor in consideration of flooding from tidal sources.

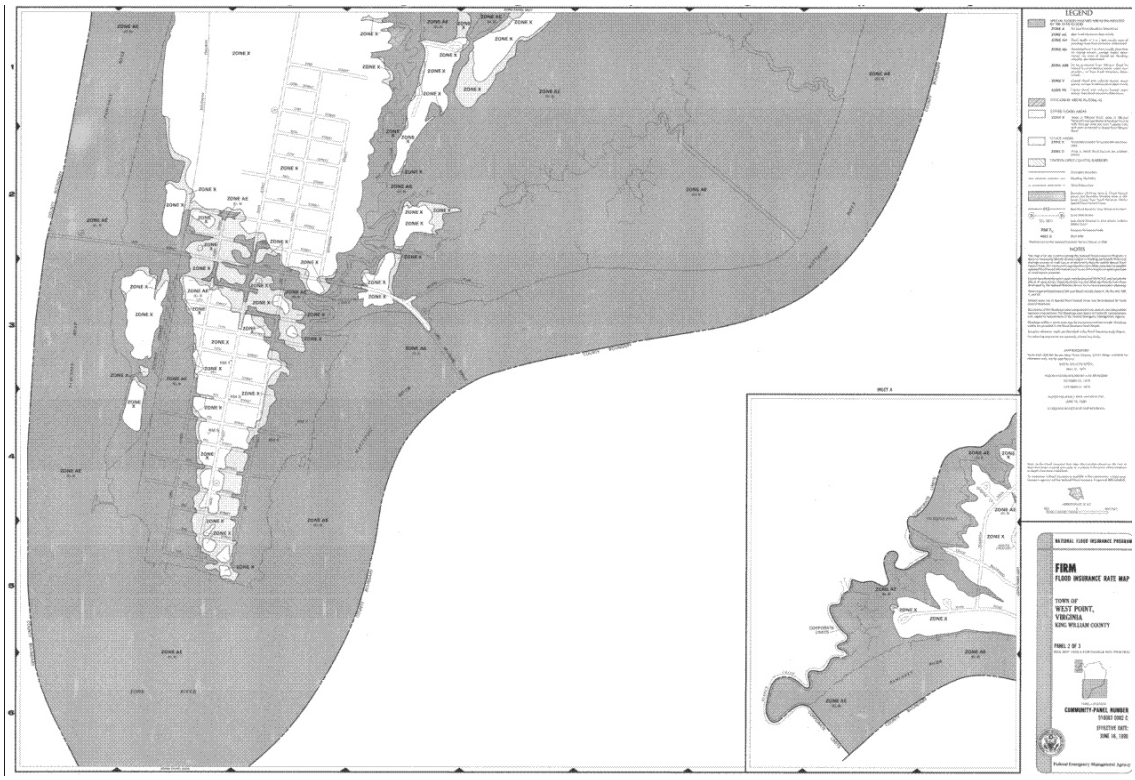
Strong east or northeast winds can push Chesapeake Bay water (storm surge) into the mouth of the York and Rappahannock Rivers and Mobjack Bay, flooding the Middle Peninsula. This surge combined with the normal high tide can increase the mean water level 15 feet or more. For illustrative purposes, *Figure 3* is a Flood Insurance Rate Map (FIRM) showing flooding during a 100-year storm event (dark grey shading) or, in other words, the storm that has 1% chance of being equaled or exceeded in any given year for lower reaches of the Town of West Point. The FIRM accounts for both coastal surge driven flooding, as well as flooding generated from rain events. The 1-percent-annual-chance flood (or 100-year flood) represents a magnitude and frequency that has a statistical probability of being equaled or exceeded in any given year, or, in other words, the 100-year flood has a 26 percent (or 1 in 4) chance of occurring over the life of a 30-year mortgage (FEMA 2002).

Along with nearly 20,000 communities across the country, all of the localities of the Middle Peninsula voluntarily participate in the National Flood Insurance Program by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes Federally backed flood insurance available to homeowners, renters, and business owners in these communities (FEMA 2002).

The U.S. Congress established the National Flood Insurance Program (NFIP) with the passage of the National Flood Insurance Act of 1968. Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Flood damage is reduced by nearly $1 billion a year through communities implementing sound floodplain management requirements and property owners

purchasing of flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance. And, every $3 paid in flood insurance claims saves $1 in disaster assistance payments (FEMA 2002).

Figure 12: An example Flood Insurance Rate Map (FIRM) for the Town of West Point.



In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the Nation's floodplains (Figure 12). Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance (FEMA 2002).

When creating the FIRMS, floodplain zones are standardized to the 100-year flood (also called the base flood or 1% chance flood), and assigned an area called the Special Flood Hazard Area (SFHA). An SFHA is a high-risk area defined as any land that would be inundated by a flood having a 1-percent chance of occurring in any given year (FEMA 2002). In the Middle Peninsula, the SFHA includes zones designated as A, AE, V, or VE (Table 8).

Under the NFIP regulations, participating NFIP communities are required to regulate all development in SFHAs. “Development” is defined as:

"any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials."

Before a property owner can undertake any development in the SFHA, a permit must be obtained from the community. The community is responsible for reviewing the proposed development to ensure that it complies with the community's floodplain management ordinance. Communities are also required to review proposed development in SFHAs to ensure that all necessary permits have been received from those governmental agencies from which approval is required by Federal or State law, such as 404 wetland permits from the Army Corps of Engineers or permits under the Endangered Species Act.

Table 8: FEMA Flood Zone Designations found in the Middle Peninsula Region

Zone VE	SFHA* along coasts subject to inundation by the 100-year flood with additional hazards due to velocity (wave action). Base flood elevations derived from detailed hydraulic analyses are shown within these zones. *Mandatory flood insurance purchase requirements apply.*
Zone A	SFHA* subject to inundation by the 100-year flood. Because detailed hydraulic analyses have not been performed, no base flood elevation or depths are shown. *Mandatory flood insurance purchase requirements apply.*
Zone AE	SFHA* subject to inundation by the 100-year flood determined in a Flood Insurance Study by detailed methods. Base flood elevations are shown within these zones. *Mandatory flood insurance purchase requirements apply.*
Zone X	These areas have been identified in the community flood insurance study as areas of moderate or minimal hazard from the principal source of flood in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. Local storm water drainage systems are not normally considered in the community's FIS. The failure of a local drainage system creates areas of high flood risk within these rate zones. *Flood insurance is available in participating communities, but is not required by regulation in these zones.*
Zone X500	The same description as Zone X, however, this area falls between the 100 and 500-year flood zone.
UNDES	Undescribed. No information available.

* SFHA = "Special Flood Hazard Area"

Under the NFIP, communities must review subdivision proposals and other proposed new development, including manufactured home parks or subdivisions to ensure that these development proposals are reasonably safe from flooding and that utilities and facilities servicing these subdivisions or other development are constructed to minimize or eliminate flood damage.

In general, the NFIP minimum floodplain management regulations require that new construction or substantially improved or substantially damaged existing buildings in A Zones must have their lowest floor (including basement) elevated to or above the Base Flood Elevation (BFE). Non-residential structures in A Zones can be either elevated or dry-flood proofed. In V Zones, the building must be elevated on piles and columns and the bottom of the lowest horizontal structural member of the lowest floor of all new construction or substantially improved existing buildings must be elevated to or above the BFE.

When the NFIP was created, the U.S. Congress recognized that insurance for “existing buildings” constructed before a community joined the Program would be prohibitively expensive if the premiums were not subsidized by the Federal Government. Congress also recognized that most of these flood-prone buildings were built by individuals who did not have sufficient knowledge of the flood hazard to make informed decisions. Under the NFIP, “existing buildings” are generally referred to as Pre-FIRM (Flood Insurance Rate Map) buildings. These buildings were built before the flood risk was known and identified on the community’s FIRM. Currently about 26 percent of the 4.3 million NFIP policies in force are Pre-FIRM subsidized compared to 70 percent of the policies being subsidized in 1978 (FEMA 2002).

Some of this flood data is available digitally so that it may be integrated with current GIS systems in place. The FEMA Q3 Flood Data provide users with flood risk information that details 100-year or 500-year floodplains at the county level and is derived from FEMA's Flood Insurance Rate Maps (FIRMs). Digital Flood data is available for three of the counties of the Middle Peninsula: Gloucester, Middlesex, and Mathews. One useful and direct application of Q3 flood data is to overlay a coverage of the Q3 data on existing coverages such as cities, road networks and individual addresses, and determine if a specific area is located within the SFHA. This process was done for each of these counties to determine the number of addressed structures within each of the flood zones. For the rest of the Middle Peninsula localities, paper FIRM maps were digitized and imported into the GIS database. The digitized images were assigned a coordinate system and georeferenced to make compatible with GIS layers containing land cover, structure, roads, and census information data. This allowed analysis of population and structures within each of the flood zones depicted in the FIRM maps.

4.4.3. Winter Ice Storms

Virginia's biggest winter storms are the great "Nor'easters". At times, Nor'easters have become so strong that they have been labeled the "White Hurricane". In order for these storms to form, several things need to occur. High pressure builds over New England. Arctic air flows south from the high center into Virginia. The colder and drier the air is, the denser and heavier it becomes. This cold, dry air is unable to move west over the Appalachian Mountains and it remains trapped to the east side, funneling down the valleys and along the coastal plain toward North Carolina. To the east of the arctic air is the warm water of the Gulf Stream. The contrast of cold air sinking into the Carolinas and the warm air sitting over the Gulf Stream creates a breeding ground for storms. Combine this with the right meteorological conditions such as the position of the jet stream, and storm development may become "explosive" (sudden, rapid intensification; dramatic drop in the central pressure of the storm) (Watson and Sammler 2004).

Winter Ice Storms occur generally as freezing rain, when precipitation, first falling as snow, melts as it passes through a warm layer of air several thousand feet above the ground. Beneath the warm layer of air is a shallow layer of freezing air just above the ground. As the liquid precipitation falls through this layer of freezing air, it becomes super-cooled, meaning that its temperature falls below freezing, but it remains a liquid. Before it has a chance to freeze solid (into sleet or ice pellets), the super-cooled liquid droplets hit the ground (or some object such as a tree limb or power line), whose temperature is also below freezing; the water then freezes on contact.

For a good Nor'easter to develop, the jet stream entering the West Coast of the United States splits. The northern branch crosses the northern Rockies and Canada while the southern branch dips to cross the Gulf Coast states, where it picks up a disturbance that it carries northeast across Virginia to rejoin the northern branch over Newfoundland. The northern branch of the jet supports the southward sinking cold air. When this disturbance interacts with the temperature boundary formed by the warm Gulf Stream waters and the arctic air mass inland, a low-pressure system forms. The strong wind from the northeast gives the low-pressure storm its name, *Nor'easter*. Wind blowing counter-clockwise around the storm center carries warm, moist air from the Gulf Stream up and over the cold inland air. The warm air rises and cools, and snow begins. The storm's speed and exact track to the north become critical in properly forecasting and warning for heavy snow across Virginia. On the Middle Peninsula, it is quite common for the rain-snow line to fall right over the northern sections of King William, King and Queen, and Essex Counties. Heavy snow often falls in a narrow 50-mile wide path about 150 miles northwest of the low-pressure center. Closer to the low's center, the warmer ocean air changes the precipitation to sleet, freezing rain and eventually rain. If the forecasted storm track is off by just a little bit, it may mean

the difference between forecasting heavy rain, freezing rain or sleet, and a foot of snow (Watson and Sammler 2004).

Intense winds around the storm's center build waves that rack the coastline and sometimes drive water inland, causing extensive coastal flooding and severe beach erosion. Unlike a hurricane, which usually comes and goes within one tidal cycle, the Nor'easter can linger through several tides, each one piling more water on shore and into the bays. The March 5-9, 1962 Nor'easter, known as the "Ash Wednesday Storm", lingered off the Virginia Capes for days. It caused over $200 million (in 1962 dollars) in property damage and major coastal erosion from North Carolina to Long Island, N.Y.

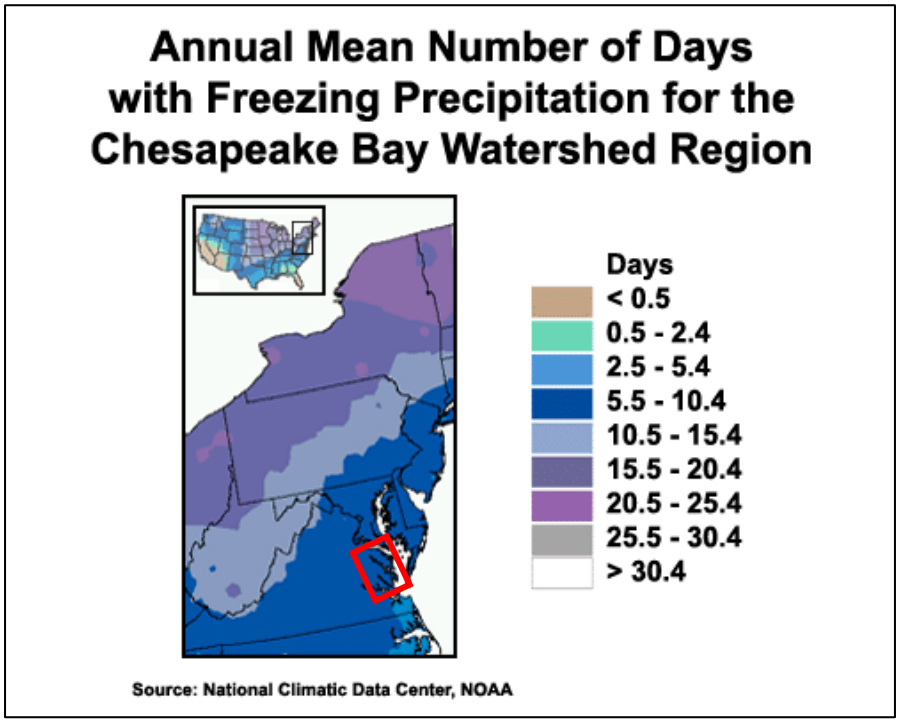


Figure 13: Map of annual mean number of days with freezing precipitation (rain or drizzle) for the Chesapeake Bay Watershed region (StormCenter Communicatons 2003). The area encompassing the Middle Peninsula is highlighted on the map with a red square.

As with snow, the frequency with which freezing rain occurs varies throughout the Chesapeake Bay watershed. In the northern part of the watershed, around Binghamton, NY, the incidence of freezing rain is one of the highest in the country. Although less common, freezing rain is still a threat even to the southern parts of the watershed. Figure 13 shows how the number of days with freezing precipitation (both rain and drizzle) in an average year varies throughout the Chesapeake Bay region. The Middle Peninsula generally experiences between 5.5 and 10.4 days of freezing rain annually.

During the winter of 1993-1994, a series of ice storms struck Virginia. The conditions for the formation of an *ice storm* are not completely unlike those for the formation of a Nor'easter. High pressure over New England funnels cold, dry arctic air south over the state. The air tries to push west but can not rise over the

Appalachian Mountains and becomes trapped on the east side. A storm moves northeast from the southern plains or Gulf Coast region. Instead of passing south and east of Virginia, it often moves up the western slopes of the mountains. As this warm, moist air rises over the mountains and the trapped cold air on the east side, precipitation begins (Figure 14). The type of precipitation depends on the depth of the cold air. At first the thickness of the cold air mass is often enough to produce snow, but as the warm air passes over the cold air and erodes it, the cold air mass gets more and more shallow. Soon the cold air mass is too thin to produce snow. Rain droplets freeze into small ice pellets, or *sleet*, as it falls through the cold air. When sleet hits the ground, it bounces and does not stick to objects (Watson and Sammler 2004).

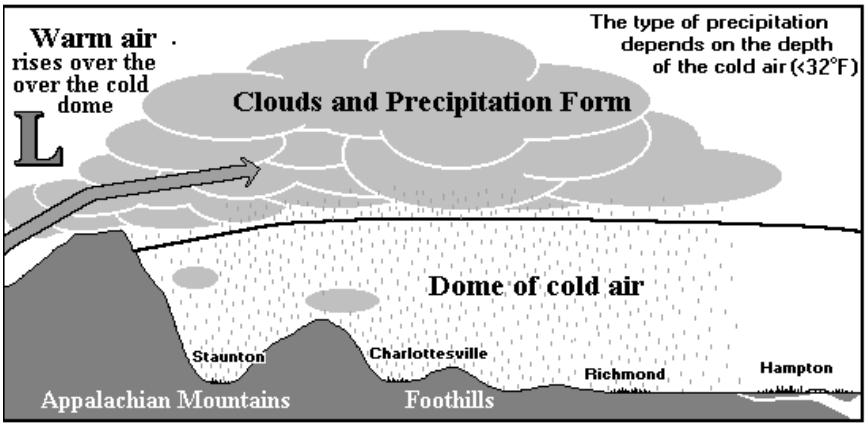


Figure 14: Ice Storm Formation (from Watson and Sammler 2004)

Eventually, the cold air mass is so shallow that the rain does not freeze. If the temperature of the earth's surface is below freezing, then rain will freeze as it hits the ground, producing *freezing rain*, a very dangerous on roadways or walkways. As the ice accumulates on trees and wires, the weight eventually causes them to break, knocking out power and phone service. Sometimes, so much ice can accumulate that structural damage and collapse can occur to buildings and communication towers. This is precisely what occurred during the “Christmas Ice Storm” of December 1998, which hit southeast Virginia, including the Middle Peninsula. Icy conditions caused injuries from slips, falls, and numerous vehicle accidents. Ice accumulations of up to an inch brought down trees and power lines. Outages were so widespread (400,000 customers on Christmas Eve) that some people were without power for up to ten days (Watson and Sammler 2004).

Other types of 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 one to four inches of snow in a narrow 50 to 60 mile-wide band. Sometimes, the high pressure and cold arctic air that follow in the wake of a clipper become the initial set up for a Nor'easter. In very rare cases, elements combine to produce very localized heavy snow without any fronts or storm

centers nearby. These events are nearly impossible to forecast with any accuracy (Watson and Sammler 2004).

General Chronology of Middle Peninsula Winter Storm Events

Historical records are invaluable to researchers trying to understand long-term patterns in the frequency and intensity of coastal storms and such data on storms and weather go back a long time in Virginia, thanks to record keeping by early weather observers such as George Washington, James Madison and Thomas Jefferson, and journals and articles written by early settlers. While early documentation of winter storms is not as extensive as that of hurricanes, here we present a brief synopsis of the major storm events that have impacted this region.

1564-1799:

The “Washington and Jefferson Snow Storm” of January 1772 was recorded in both George Washington's and Thomas Jefferson's diaries. The storm left 30 to 36 inches of snow from Charlottesville to Winchester to Washington, D.C., and remains the unofficial record. While it is unclear exactly how this storm affected the Middle Peninsula region, the deep snow pack prevented travel for up to two weeks, and postal service was stopped for five weeks.

The “Hard Winter of 1779-1780” was so cold that ice was said to have been piled 20 feet high along the Virginia Coast and stayed there until spring. The upper portion of the Chesapeake Bay was frozen, allowing people to walk from Annapolis to Kent Island, Md. The Virginia portion of the Bay was frozen near the mouth. All waterways in Virginia were also frozen and were firm enough to support the crossing of a regiment of the Virginia Infantry fighting the War of Independence as it marched from Falmouth to Fredericksburg, crossing the Rappahannock River, which had been frozen since the previous November (Watson and Sammler 2004).

The “Long Winter of 1783-1784” was not as cold as in 1780, but this winter lasted longer into the spring and was thought to rank near the top for extremes in cold and snow. The Chesapeake Bay once again froze almost all the way to the mouth. James Madison in Orange County wrote in a letter to Thomas Jefferson, "We had a severer season and particularly a greater quantity of snow than is remembered to have distinguished any preceding winter." The thaw caused an ice jam on the James River at Richmond that gave way, causing a flash flood of ice and water that swept away a bridge and sank boats that were tied up below the falls. Ice on the Potomac did not break until March 15th (Watson and Sammler 2004).

A snowstorm on February 14, 1798 was reported in the Norfolk Herald to have dumped snow in Norfolk "in many places up to six feet deep," the greatest

snowfall ever experienced. Some accounts claim that 40 inches of snow fell in one night in Norfolk and along the coast, but no snow fell 25 miles inland. Over northeast North Carolina, 16 inches of snow was reported. Wind blowing from the north to northwest off the Chesapeake Bay may have enhanced the snowfall in the Norfolk area, much like the winds blowing across Lake Erie produce "lake effect snow" in New York (Watson and Sammler 2004).

1800-1899:

In January 1835, Alexandria recorded the temperature at -15°F. The Potomac River was frozen and the Chesapeake Bay froze down to the Virginia Capes for the first time in almost 50 years (Watson and Sammler 2004).

A heavy snowstorm dropped up to 30 inches of snow in the Tidewater area March 16-18, 1841 (Watson and Sammler 2004).

More than a foot of snow fell with temperatures below 20°F across the state during the Great Blizzard and Freeze of January 1857. Strong winds caused structural damage on land, wrecked ships at sea and great drifts that blocked transportation through the state. One report states that Norfolk was buried under 20 foot drifts of snow. Temperatures fell below zero after the storm: The cold was so extreme that all Virginia rivers were frozen over. The Chesapeake Bay was solid ice a 1 ½ miles out from its coast. At Cape Henry, one could walk out 100 yards from the lighthouse on the frozen ocean (Watson and Sammler 2004).

1900-1999:

The “Knickerbocker Storm” of January 1922 struck Virginia exactly 150 years after the “Washington and Jefferson Storm” and brought with it the deepest snow of the 20th century to hit Virginia. The storm struck from South Carolina to Massachusetts with a heavy snow band stretching across Richmond (19 inches) and Washington, D.C. (25 inches), immobilizing the region. The weight of the snow was too much for the Knickerbocker Theater in Washington, D.C. and it collapsed, crushing 98 people to death and injuring 130 (Watson and Sammler 2004).

In February 1936, over 14 inches of snow fell in the Northern Virginia with greater amounts in the Skyline Drive area. Over eight inches of snow fell at the Walkerton Snow Cover Monitoring station in King and Queen County (Rayburn and Lozier 2001). The heavy snow set the stage for the great spring flood in March when warm temperatures brought a sudden thaw to the snow pack.

A January 1940 snowstorm set record accumulations for the state. The storm dropped almost two feet of snow (21.6 inches) in 24 hours and helped set a record for the month of 28.5 inches. Over eight inches of snow fell at the Walkerton Snow Cover Monitoring station in King and Queen County and

remained on the ground for 11 days (Rayburn and Lozier 2001). Richmond was shut down with drifts as deep as four feet. Businesses were closed for a couple of days and some schools for a week. There were 12 deaths attributed to the storm in Virginia with damages estimated at $500,000.

A blizzard struck Virginia and the Northeast U.S on January 30-31, 1966. This was the second snowstorm to hit Virginia in a week. The first storm dumped 15 inches in Richmond and 9 inches in Norfolk. With fresh snow on the ground, arctic air settled in and temperatures dropped into the teens. The second storm dumped one to two feet of snow over a large part of the state. Snow cover at Walkerton exceeded 8 inches for 12 days, 10 days at West Point, and 15 days in Urbanna (Rayburn and Lozier 2001). Intense blowing and drifting snow continued and kept roads closed for several more days after the storm. Temperatures dropped into the single digits with some falling below zero. Wind chill temperatures were dangerously low. The Richmond area went on to set a record for the calendar year with 41.6 inches.

On January 4 and 5, 1980, a heavy wet snow fell over eastern Virginia with as much as 18 inches reported at Williamsburg. A second storm hit on February 6 that dumped 6 inches in Williamsburg and as much as 20 inches at Virginia Beach. Over a foot of snow fell in Norfolk. This was topped on March 1. Once again, arctic air had settled over Virginia and temperatures were in the teens. More than a foot (13.7 inches) of snow fell in Norfolk. The heavy snow combined with strong winds created blizzard conditions. Norfolk's total for the season came to a record 41.9 inches making this the snowiest winter ever for eastern Virginia.

A major ice storm struck central and southeast Virginia, including the Middle Peninsula, beginning on Wednesday, December 23, 1998 and lasting into Friday, December 25, Christmas Day. Icy conditions caused injuries from slips and falls and numerous vehicle accidents. Ice accumulations of up to an inch brought down trees and power lines. Outages were so widespread (400,000 customers on Christmas Eve) that some people were without power for up to ten days.

4.4.4. Tornadoes

The National Weather Service defines a tornado as a violently rotating column of air in contact with the ground and extending from the base of a thunderstorm. A condensation funnel does not need to reach to the ground for a tornado to be present; a debris cloud beneath a thunderstorm is all that is needed to confirm the presence of a tornado, even without a condensation funnel.

Tornadoes are distinguishable from waterspouts, which are small, relatively weak rotating columns of air over water beneath a cumulonimbus or towering cumulus cloud. Waterspouts are most common over tropical or subtropical waters. The exact definition of waterspout is debatable. In most cases the term is reserved for small vortices over water that are not associated with storm-scale rotation

(i.e., they are the water-based equivalent of landspouts). But there is sufficient justification for calling virtually any rotating column of air a waterspout if it is in contact with a water surface.

Tornadoes often appear as a funnel shaped cloud or a spiraling column of debris extending from storm clouds to the ground. They are created during severe weather events like thunderstorms and hurricanes when cold air overrides a layer of warm air, causing the warm air to rise rapidly. Tornadoes may be only several yards across, or in rare cases, over a mile wide. Winds within a tornado can reach speeds over 250 mph, but most tornado winds are 100 mph or less. Weak tornadoes (categorized as F0 and F1 on the Fujita scale, Table 9) are most common on the Middle Peninsula and often last only a minute before dissipating. From 1950 through the year 2001, 376 tornadoes were documented in Virginia (Watson 2002). July is the most active month for tornadoes in Virginia. The hot, humid days common to July are often accompanied by a late afternoon or evening thunderstorm. The hot temperatures and humidity of the late afternoon fuel the thunderstorm's growth. If certain conditions are right, a tornado may develop. Hurricane-induced tornadic activity can also occur close to the coastline as a hurricane makes landfall (Watson 2002).

Virginia's tidewater counties see a fair number of tornadoes for two reasons, both of which are related to the region’s proximity to Chesapeake Bay and the coast. One reason is that waterspouts are common. Occasionally a waterspout will come onshore and do some damage. Once the waterspout comes onshore, it is considered a tornado and is generally classified as a F0. The second reason this area sees an increase in tornadoes is that often during the warm months there is a bay breeze or sea breeze front (bay or sea cooled air on one side of the front and land heated air on the other). When a large rotating thunderstorm moves over a boundary/front such as this, there is an increased chance that conditions will be right for the development of a tornado (Watson 2002).

Between 1950 and 2004, eleven tornadoes were reported in Gloucester County, six in Middlesex, five in Mathews, three each in King and Queen and Essex Counties, and two in King William (Watson 2002; NCDC Storm Event Database). While the historic data appears to show that the Middle Peninsula has a low annual probability of being struck by a tornado (Figures 15 and 16), it is important to note that because tornadoes can result from severe thunderstorms and hurricanes, the susceptibility of this region to these storms carries the threat of tornadoes along with it.

Table 9: Fujita Scale of tornado intensity

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 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 reinforced 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

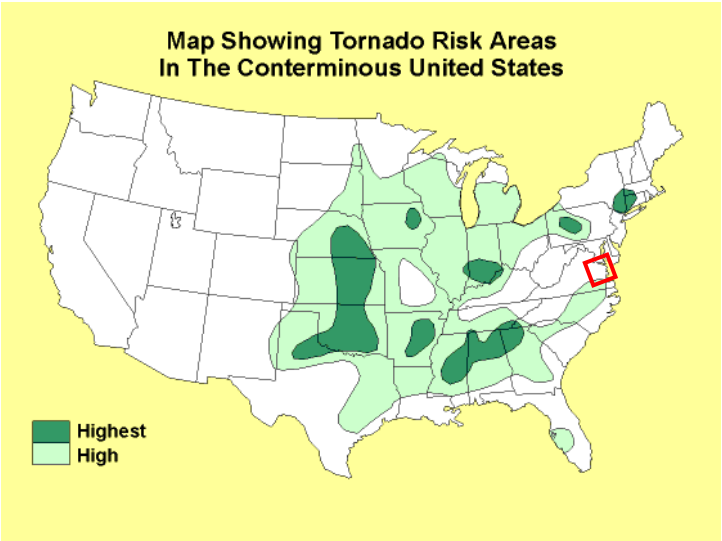


Figure 15: Map Showing Tornado Risk Areas in the Conterminous United States. The categories shown reflect the tornado recurrence interval at a single point. In the highest risk areas, a tornado of significant strength would be expected to occur once every 2000 years, at each point in the area shown. For the high-risk areas, the interval would be once every 5000 years. The database is 800 cases of significant tornadoes for the period 1954-1992. The Middle Peninsula, depicted here as Low Risk, is indicated by the area within the red square. Map courtesy USGS (http://www.usgs.gov/themes/map6.html)

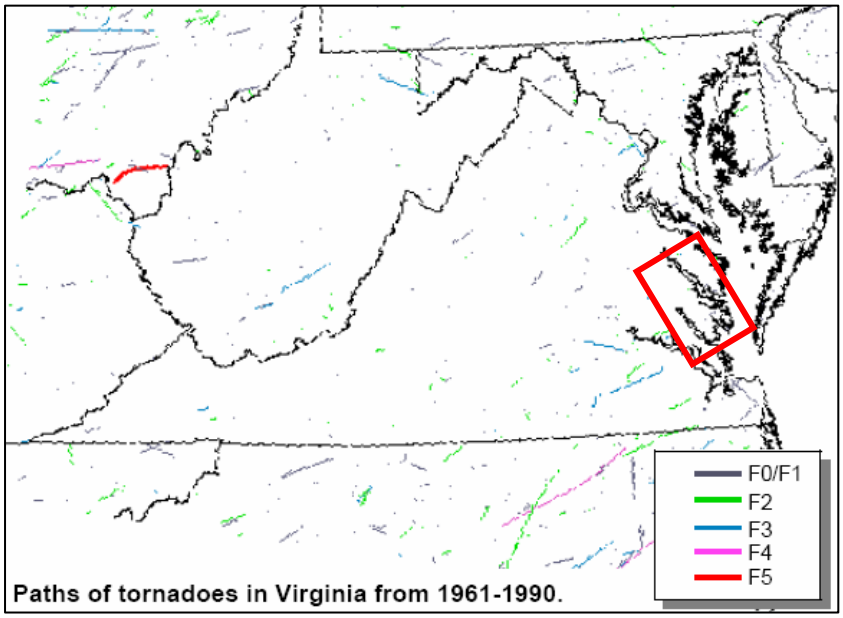


Figure 16: Tornado paths in Virginia from 1961-1990. Color of line paths correspond to the intensity of the tornado according to the Fujita scale (Table 6). The area of the Middle Peninsula is highlighted by the red box. Image courtesy of Southeast Regional Climate Center (2005).

5. Vulnerability Assessment:

To assess the vulnerability of the Middle Peninsula, particularly to natural hazards, an inventory of each community's structures and critical facilities was conducted. Data are presented by Census block group within each county (Figures 17-23).

The critical facilities are the community's assets that are the most important or vital to emergency management functions (i.e. response and recovery activities), or for daily continuity of government services. Critical facilities are those facilities that warrant special attention in preparing for a disaster and/or facilities that are of vital importance to maintaining citizen life, health, and safety during and/or directly after a disaster event. The Middle Peninsula has prepared an inventory of critical facilities that include emergency response facilities such as police stations, fire departments, emergency medical service stations (EMS), public facilities including schools and local government buildings, and sanitary pump stations.

From the Region's list of critical facilities, a location analysis was performed to determine how many structures would be affected by a 100-year flood event (as per the Flood Insurance Rate Maps (FIRMs) for the region).

The following section describes the vulnerabilities of each Middle Peninsula locality to natural hazards that are common throughout the Middle Peninsula region and deemed "Critical Hazards" to the Middle Peninsula by the RAMP Committee: Hurricanes (including Coastal Storms), Coastal Flooding, Winter Ice Storms, and Tornadoes.

Figure 17: Essex County Census Block Groups

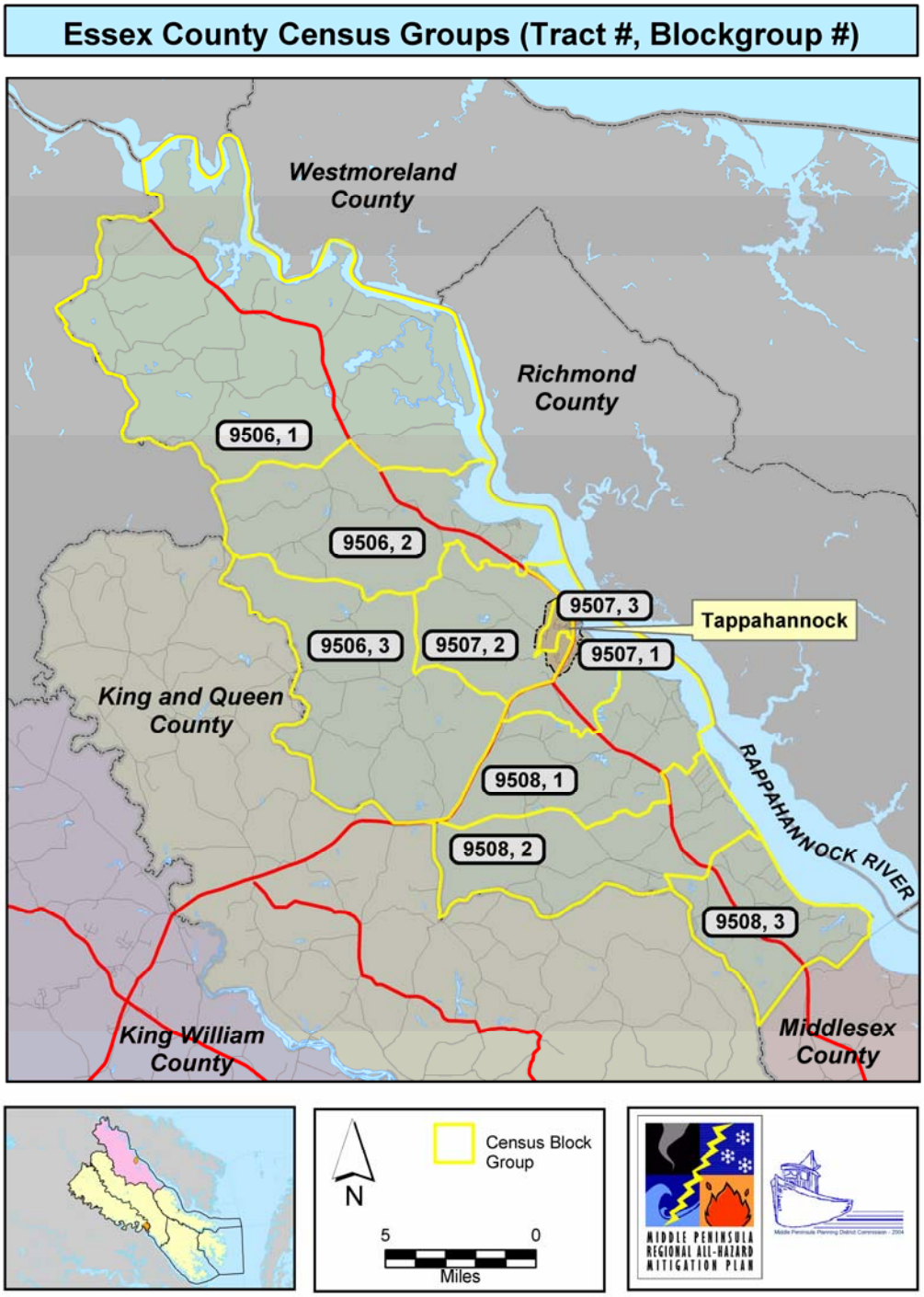


Figure 18: Northern Gloucester County Census Block Groups

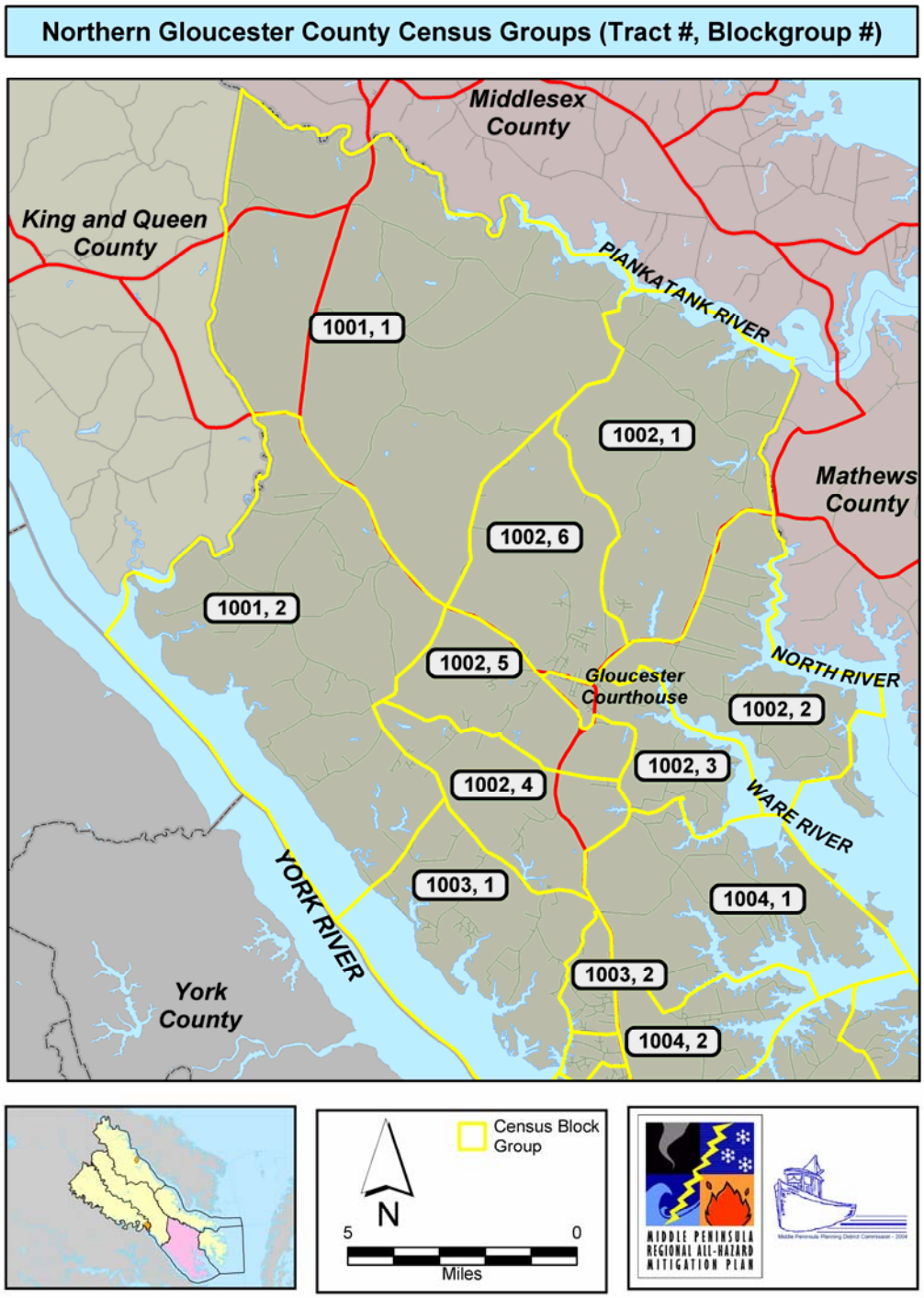


Figure 19: Southeast Gloucester County Census Block Groups

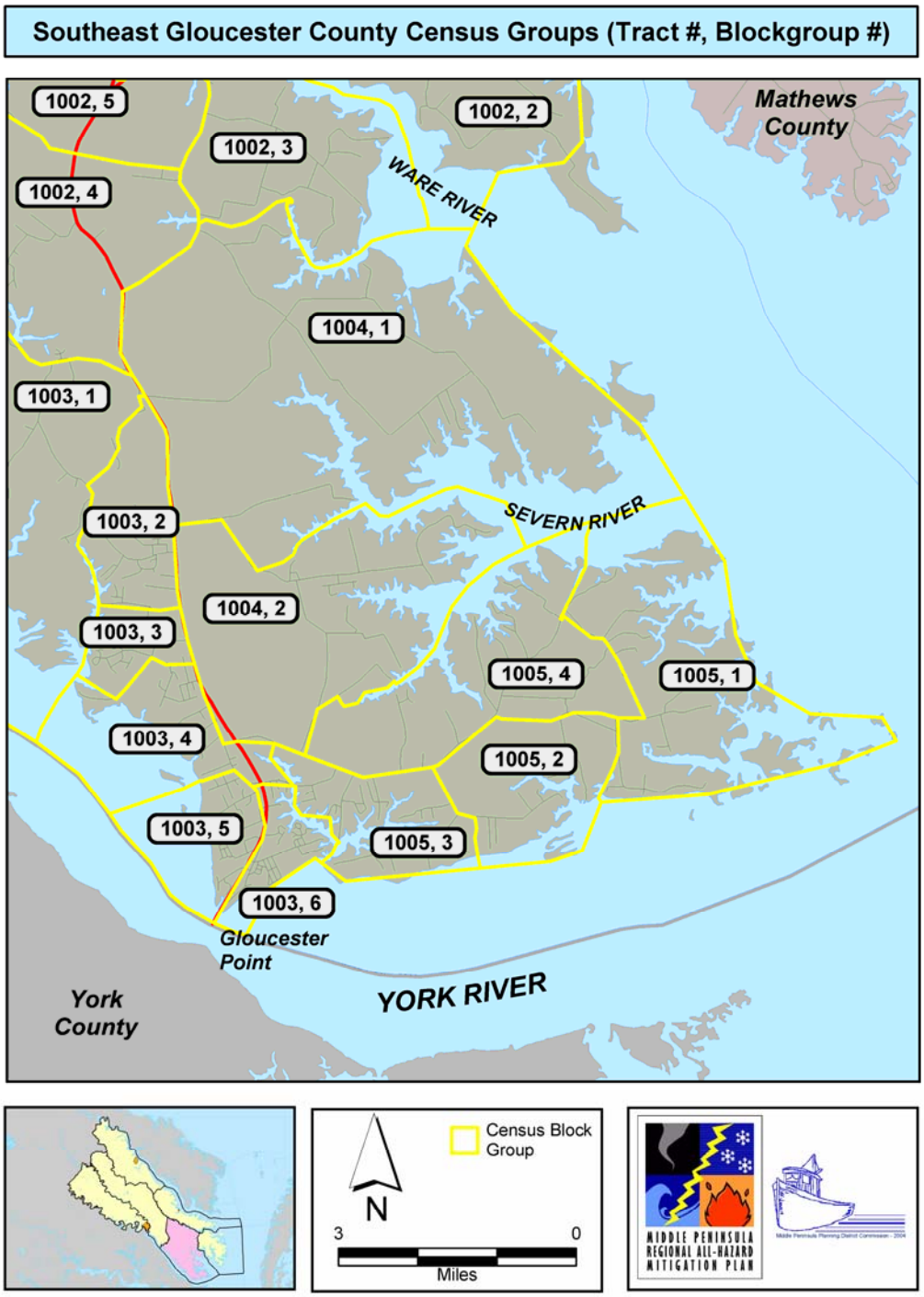


Figure 20: King and Queen County Census Block Groups

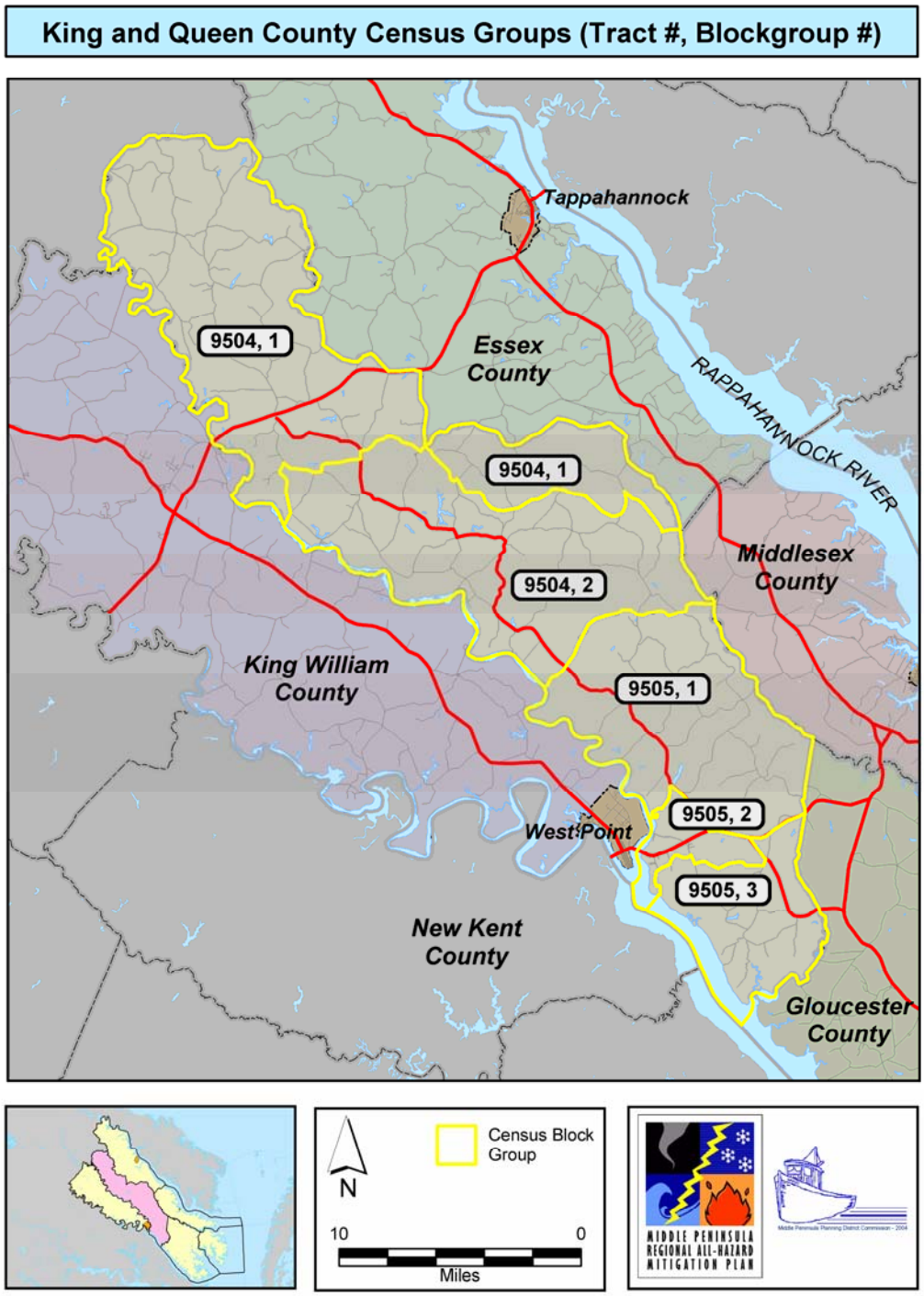


Figure 21: King William County Census Block Groups

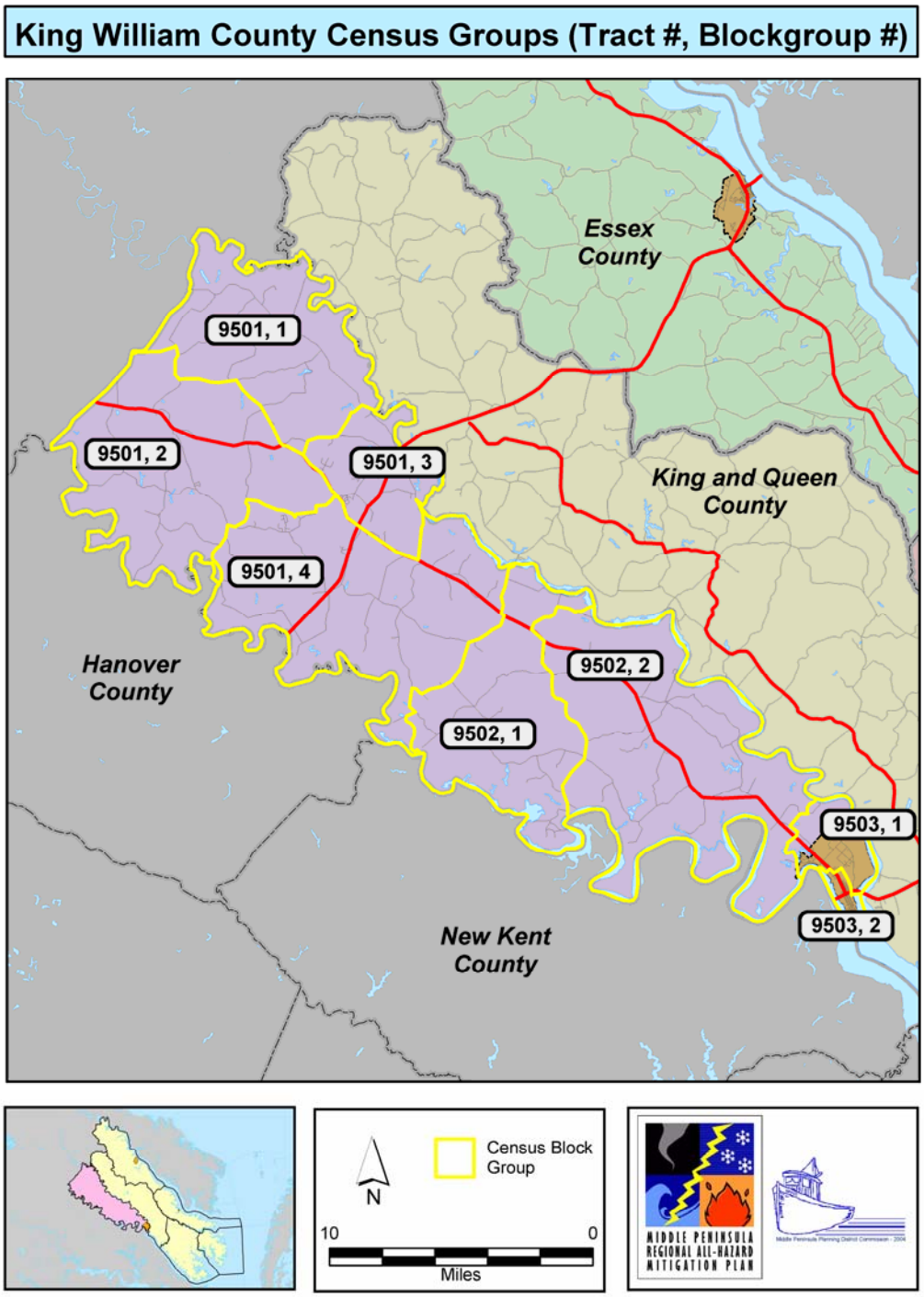


Figure 22: Mathews County Census Block Groups

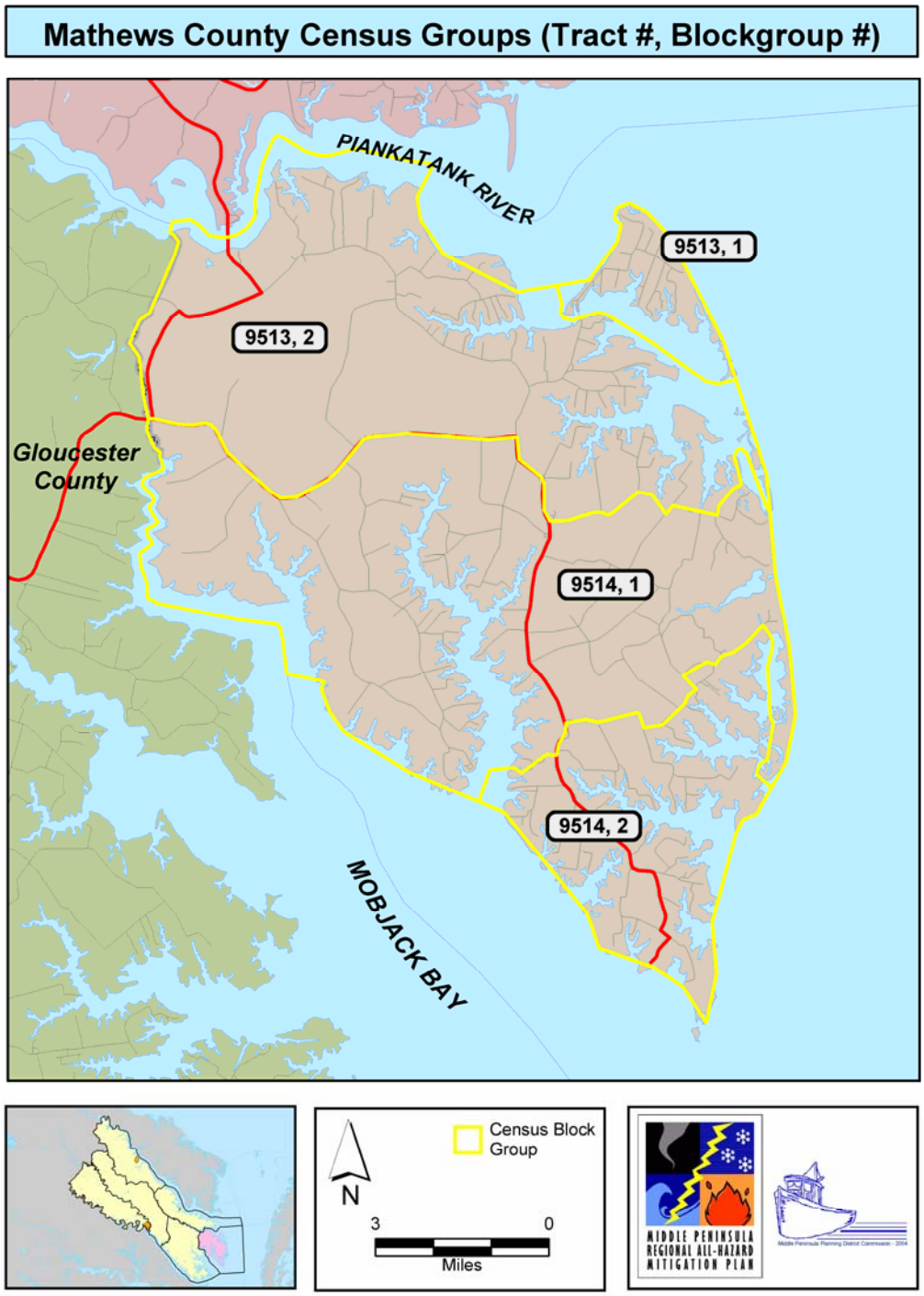
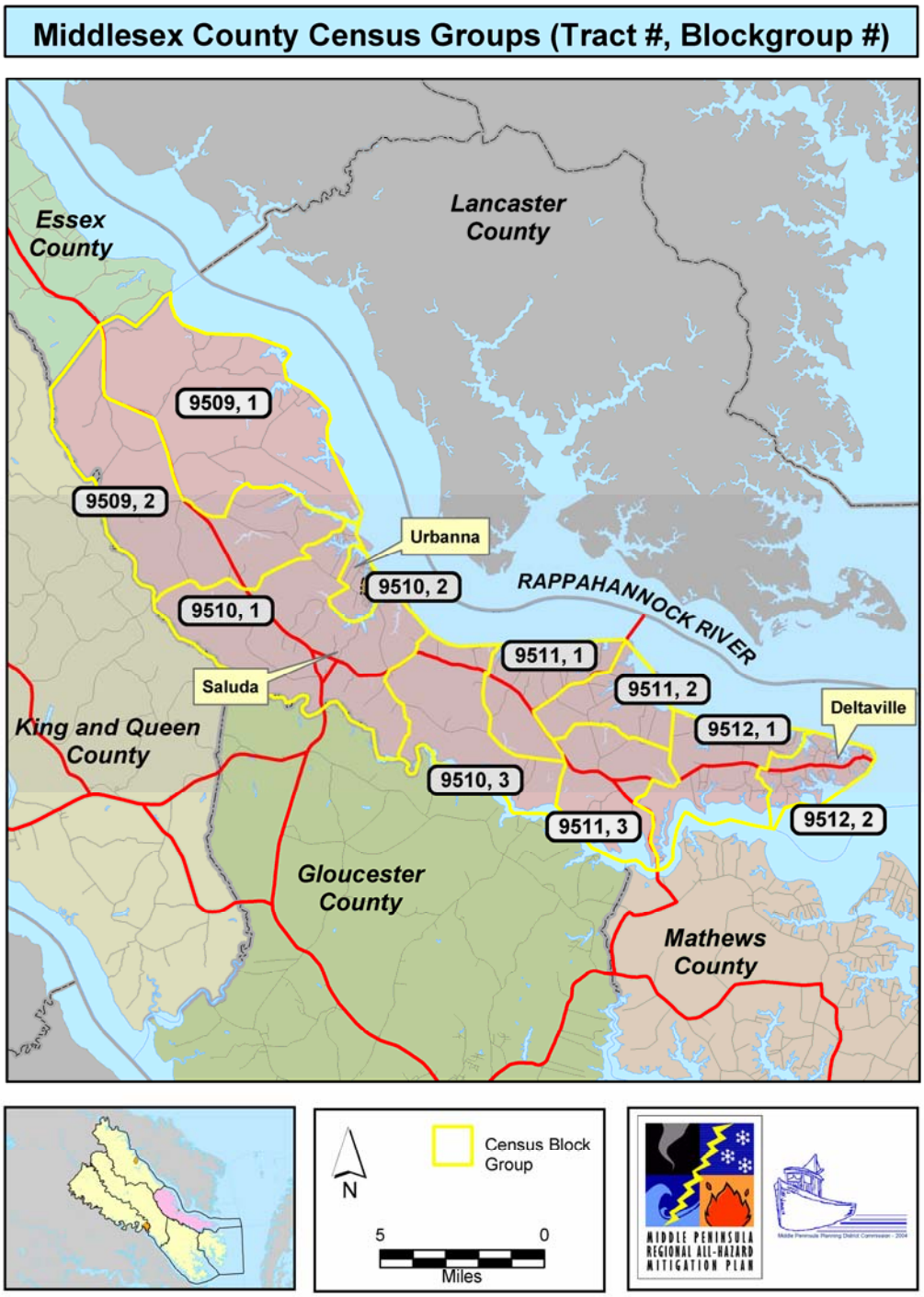


Figure 23: Middlesex County Census Block Groups



5.1. Hurricanes and Coastal Storms:

Hurricane storm inundation information was developed as part of the Virginia Hurricane Evacuation Study for the Tidewater and Hampton Roads region. Although all Middle Peninsula localities experienced storm surge during Hurricane Isabel in September 2003, the only Middle Peninsula jurisdictions with available surge maps were the Counties of Gloucester, Mathews, and Middlesex. Paper maps were digitized to make compatible with the existing MPPDC GIS database. The digitized images were assigned a coordinate system and georeferenced to make compatible with GIS layers containing land cover, structure, roads, and census information data. This allowed analysis of population and structures within hurricane surge zones depicted in the hurricane surge zone maps. Values of structures within each census block group were conservatively estimated from Census 2000 data. The following sections describe the vulnerabilities of these counties to Hurricane Storm Surges.

5.1.1. Gloucester County

Table 10 (parts A-E) provide detailed potential loss estimates of addressed structures in Gloucester County that fall within surge zones for Category 2, 3, and 4 Hurricane storms. Data are arranged in columns by census block group, which corresponds with the areas pictured in Figures 18 and 19. Nearly 23% of the County's addressed structures, or 3,443 structures, lie within a surge zone for a Category 2 type storm and run the risk of damage from storm surge inundation. The census block groups most potentially severely effected by such a storm surge lie on Guinea Neck in the southeastern reaches of the county (Census Tract 1005, Block Groups 1, 2, 3, 4; see Table 10 D), Bena, Achilles, Maryus, and Severn. Every structure (100%) within in these four Census Block Groups runs the risk of inundation by a Category 2 event. In the event of a category 2 storm, losses to personal property in Gloucester County is conservatively estimated to be nearly $340 million.

A total of 3,994 structures (which include those potentially impacted by a Category 2 storm), over 26% of the County's addressed structures, lie within the surge zone for a Category 3 Hurricane, causing an estimated $459 million in damages. Another 600 structures may be inundated by the storm surge from a Category 4 storm, causing over $527 million in property loss.

Table 10 A: Vulnerability of addressed structures to category 2, 3, and 4 hurricanes in Gloucester County

	Block Group 1, Census Tract 1001, Gloucester County, Virginia	Block Group 2, Census Tract 1001, Gloucester County, Virginia	Block Group 1, Census Tract 1002, Gloucester County, Virginia	Block Group 2, Census Tract 1002, Gloucester County, Virginia	Block Group 3, Census Tract 1002, Gloucester County, Virginia
Land Area (square meters)	140,207,220	85,462,262	58,835,658	33,895,829	15,593,879
Total population: Census 2000	2421	4216	3133	1110	1021
Housing units: Total	1026	1691	1243	582	474
Total number of structures (based on E911 GIS data)	1171	1834	1438	615	484
Median value of owner-occupied housing from Census 2000	$97,100	$85,700	$113,500	$142,200	$120,300
Number of structures potentially damaged by a **Category 2** hurricane	37	126	72	339	73
Potential property loss by a **Category 2** hurricane	$3,592,700	$10,798,200	$8,172,000	$48,205,800	$8,781,900
Percent of Total Structures potentially damaged by a **Category 2** hurricane	3.16%	6.87%	5.01%	55.12%	15.08%
Number of structures potentially damaged by a **Category 3** hurricane	106	162	112	502	101
Potential property loss by a **Category 3** hurricane	$10,292,600	$13,883,400	$12,712,000	$71,384,400	$12,150,300
Percent of Total Structures potentially damaged by a **Category 3** hurricane	9.05%	8.83%	7.79%	81.63%	20.87%
Number of structures potentially damaged by a **Category 4** hurricane	137	223	154	550	144
Potential property loss by a **Category 4** hurricane	$13,302,700	$19,111,100	$17,479,000	$78,210,000	$17,323,200
Percent of Total Structures potentially damaged by a **Category 4** hurricane	11.70%	12.16%	10.71%	89.43%	29.75%

Table 10 B: Vulnerability of addressed structures to category 2, 3, and 4 hurricanes in Gloucester County (continued).

	Block Group 4, Census Tract 1002, Gloucester County, Virginia	Block Group 5, Census Tract 1002, Gloucester County, Virginia	Block Group 6, Census Tract 1002, Gloucester County, Virginia	Block Group 1, Census Tract 1003, Gloucester County, Virginia	Block Group 2, Census Tract 1003, Gloucester County, Virginia
Land Area (square meters)	26,220,244	23,601,856	29,609,053	32,377,633	5,729,718
Total population: Census 2000	1966	1681	2972	2777	1782
Housing units: Total	703	753	1022	1055	652
Total number of structures (based on E911 GIS data)	789	837	1103	1147	693
Median value of owner-occupied housing from Census 2000	$117,400	$100,600	$109,200	$114,100	$91,200
Number of structures potentially damaged by a **Category 2** hurricane	0	0	1	41	20
Potential property loss by a **Category 2** hurricane	$0	$0	$109,200	$4,678,100	$1,824,000
Percent of Total Structures potentially damaged by a **Category 2** hurricane	0.00%	0.00%	0.09%	3.57%	2.89%
Number of structures potentially damaged by a **Category 3** hurricane	0	0	8	100	24
Potential property loss by a **Category 3** hurricane	$0	$0	$873,600	$11,410,000	$2,188,800
Percent of Total Structures potentially damaged by a **Category 3** hurricane	0.00%	0.00%	0.73%	8.72%	3.46%
Number of structures potentially damaged by a **Category 4** hurricane	0	1	25	189	51
Potential property loss by a **Category 4** hurricane	$0	$100,600	$2,730,000	$21,564,900	$4,651,200
Percent of Total Structures potentially damaged by a **Category 4** hurricane	0.00%	0.12%	2.27%	16.48%	7.36%

Table 10 C: Vulnerability of addressed structures to category 2, 3, and 4 hurricanes in Gloucester County (continued).

	Block Group 3, Census Tract 1003, Gloucester County, Virginia	Block Group 4, Census Tract 1003, Gloucester County, Virginia	Block Group 5, Census Tract 1003, Gloucester County, Virginia	Block Group 6, Census Tract 1003, Gloucester County, Virginia	Block Group 1, Census Tract 1004, Gloucester County, Virginia
Land Area (square meters)	2,653,300	3,989,846	2,295,964	2,100,072	41,895,112
Total population: Census 2000	1509	1967	1673	1184	795
Housing units: Total	616	869	740	578	430
Total number of structures (based on E911 GIS data)	618	656	658	565	467
Median value of owner-occupied housing from Census 2000	$89,200	$111,400	$118,700	$123,700	$124,400
Number of structures potentially damaged by a **Category 2** hurricane	19	67	13	135	377
Potential property loss by a **Category 2** hurricane	$1,694,800	$7,463,800	$1,543,100	$16,699,500	$46,898,800
Percent of Total Structures potentially damaged by a **Category 2** hurricane	3.07%	10.21%	1.98%	23.89%	80.73%
Number of structures potentially damaged by a **Category 3** hurricane	19	82	23	213	389
Potential property loss by a **Category 3** hurricane	$1,694,800	$9,134,800	$2,730,100	$26,348,100	$48,391,600
Percent of Total Structures potentially damaged by a **Category 3** hurricane	3.07%	12.50%	3.50%	37.70%	83.30%
Number of structures potentially damaged by a **Category 4** hurricane	47	110	68	332	401
Potential property loss by a **Category 4** hurricane	$4,192,400	$12,254,000	$8,071,600	$41,068,400	$49,884,400
Percent of Total Structures potentially damaged by a **Category 4** hurricane	7.61%	16.77%	10.33%	58.76%	85.87%

Table 10 D: Vulnerability of addressed structures to category 2, 3, and 4 hurricanes in Gloucester County (continued).

	Block Group 2, Census Tract 1004, Gloucester County, Virginia	Block Group 1, Census Tract 1005, Gloucester County, Virginia	Block Group 2, Census Tract 1005, Gloucester County, Virginia	Block Group 3, Census Tract 1005, Gloucester County, Virginia	Block Group 4, Census Tract 1005, Gloucester County, Virginia
Land Area (square meters)	18,454,625	12,284,068	6,790,218	5,937,275	13,087,898
Total population: Census 2000	689	623	648	1642	971
Housing units: Total	306	311	311	746	386
Total number of structures (based on E911 GIS data)	387	336	315	715	432
Median value of owner-occupied housing from Census 2000	$109,800	$79,000	$117,400	$123,700	$102,800
Number of structures potentially damaged by a **Category 2** hurricane	265	336	315	715	432
Potential property loss by a **Category 2** hurricane	$29,097,000	$26,544,000	$36,981,000	$88,445,500	$44,409,600
Percent of Total Structures potentially damaged by a **Category 2** hurricane	68.48%	100.00%	100.00%	100.00%	100.00%
Number of structures potentially damaged by a **Category 3** hurricane	295	336	315	715	432
Potential property loss by a **Category 3** hurricane	$32,391,000	$26,544,000	$36,981,000	$88,445,500	$44,409,600
Percent of Total Structures potentially damaged by a **Category 3** hurricane	76.23%	100.00%	100.00%	100.00%	100.00%
Number of structures potentially damaged by a **Category 4** hurricane	304	336	315	715	432
Potential property loss by a **Category 4** hurricane	$33,379,200	$26,544,000	$36,981,000	$88,445,500	$44,409,600
Percent of Total Structures potentially damaged by a **Category 4** hurricane	78.55%	100.00%	100.00%	100.00%	100.00%

Table 10 E: Vulnerability of addressed structures to category 2, 3, and 4 hurricanes in Gloucester County (continued).

	Gloucester totals:
Land Area (square meters)	**561,021,730**
Total population: Census 2000	
Housing units: Total	**14494**
Total number of structures (based on E911 GIS data)	**15246**
Median value of owner-occupied housing from Census 2000	
Number of structures potentially damaged by a **Category 2** hurricane	**3443**
Potential property loss by a **Category 2** hurricane	**$393,361,000**
Percent of Total Structures potentially damaged by a **Category 2** hurricane	**22.56%**
Number of structures potentially damaged by a **Category 3** hurricane	**3994**
Potential property loss by a **Category 3** hurricane	**$459,387,600**
Percent of Total Structures potentially damaged by a **Category 3** hurricane	**26.17%**
Number of structures potentially damaged by a **Category 4** hurricane	**4594**
Potential property loss by a **Category 4** hurricane	**$527,124,800**
Percent of Total Structures potentially damaged by a **Category 4** hurricane	**30.10%**

5.1.2. Mathews County

Table 11 provides detailed potential loss estimates of addressed structures in Mathews County that fall within surge zones for Category 2, 3, and 4 Hurricane storms. Data are arranged in columns by census block group, which corresponds with the areas pictured in Figure 22. Over 51% of all of the County's addressed structures, or 2,887 structures, lie within a surge zone for a Category 2 type storm and run the risk of damage from storm surge inundation. Census Tract 9514, census Block Group 2, at the southern end of Mathews County, has the greatest potential to be most severely effected by such a storm event because over 89% of the structures in this block group lie within the Category 2 storm surge zone. In the event of a Category 2 storm, losses to personal property in Mathews County is conservatively estimated to be over $309 million.

A total of 4,257 structures (which include those potentially impacted by a Category 2 storm), over 75% of the County's addressed structures, lie within the surge zone for a Category 3 Hurricane, causing an estimated $461 million in damages. Another 400 structures may be inundated by the storm surge from a Category 4 storm, causing over $507 million in property loss.

Table 11: Vulnerability of addressed structures to category 2, 3, and 4 hurricanes in Mathews County.

	Block Group 1, Census Tract 9513, Mathews County, Virginia	Block Group 2, Census Tract 9513, Mathews County, Virginia	Block Group 1, Census Tract 9514, Mathews County, Virginia	Block Group 2, Census Tract 9514, Mathews County, Virginia	**Mathews totals:**
Land Area (square meters)	6,112,652	85,232,985	98,022,303	32,553,545	221,921,485
Total population: Census 2000	705	3705	3260	1537	
Housing units: Total	670	1974	1731	958	**5333**
Total number of structures (based on E911 GIS data)	665	2093	1923	951	**5632**
Median value of owner-occupied housing from Census 2000	$92,600	$131,500	$102,000	$105,000	
Number of structures potentially damaged by a **Category 2** hurricane	393	552	1095	847	**2887**
Potential property loss by a **Category 2** hurricane	$36,391,800	$72,588,000	$111,690,000	$88,935,000	**$309,604,800**
Percent of Total Structures potentially damaged by a **Category 2** hurricane	59.10%	26.37%	56.94%	89.06%	**51.26%**
Number of structures potentially damaged by a **Category 3** hurricane	595	1008	1709	945	**4257**
Potential property loss by a **Category 3** hurricane	$55,097,000	$132,552,000	$174,318,000	$99,225,000	**$461,192,000**
Percent of Total Structures potentially damaged by a **Category 3** hurricane	89.47%	48.16%	88.87%	99.37%	**75.59%**
Number of structures potentially damaged by a **Category 4** hurricane	665	1226	1815	951	**4657**
Potential property loss by a **Category 4** hurricane	$61,579,000	$161,219,000	$185,130,000	$99,855,000	**$507,783,000**
Percent of Total Structures potentially damaged by a **Category 4** hurricane	100.00%	58.58%	94.38%	100.00%	**82.69%**

5.1.3. Middlesex County and the Town of Urbanna

Table 12 (A-C) provides detailed potential loss estimates of addressed structures in Middlesex County and the Town of Urbanna that fall within surge zones for Category 2, 3, and 4 Hurricane storms. Data are arranged in columns by census block group, which corresponds with the areas pictured in Figure 23. As a whole, Middlesex County is far less vulnerable to hurricane storm surge compared to Gloucester and Mathews Counties, but three census block groups run the risk of over 20% damage to structures by a Category 2 storm. These include the northern-most census block group on the shores of the Rappahannock River, which includes the Water View area, and the eastern-most reaches of the county near Deltaville. Over 22% of all the County's addressed structures, or 3,443 structures, lie within a surge zone for a Category 2 type storm and run the risk of damage from storm surge inundation. In the event of a Category 2 storm, losses to personal property in Middlesex County is conservatively estimated to be over $393 million.

The hurricane storm inundation information developed as part of the Virginia Hurricane Evacuation Study for the Tidewater and Hampton Roads region did not estimate storm surge for a Category 3 storm, but only gave estimated inundation zones for Category 2 and 4 storm events. A Category 4 storm event would be much more devastating to Middlesex County. Another 896 structures, for a total of 2,087 structures (which include those potentially impacted by a Category 2 storm), comprising over 30% of the County's addressed structures, lie within the surge zone for a Category 4 Hurricane, causing an estimated $257 million in damages.

A Category 2 storm would only impact 5% (approximately 22) addressed structures in the Town of Urbanna, causing an estimated $3 million in personal property losses. A Category 4 storm could wipe out over 31% of the addressed structures in Urbanna, raising the damage figure to over $19 million.

Table 12 A: Middlesex County Hurricane Surge Vulnerability

	Block Group 1, Census Tract 9509, Middlesex County, Virginia	Block Group 2, Census Tract 9509, Middlesex County, Virginia	Block Group 1, Census Tract 9510, Middlesex County, Virginia	Block Group 2, Census Tract 9510, Middlesex County, Virginia	Block Group 3, Census Tract 9510, Middlesex County, Virginia
Land Area (square meters)	73,444,328	66,836,616	65,854,010	4,875,244	32,507,971
Total population: Census 2000	786	775	1530	947	1043
Housing units: Total	536	414	737	564	650
Total number of structures (based on E911 GIS data)	610	472	942	236	720
Median value of owner-occupied housing from Census 2000 (H085001)	$90,900	$77,700	$81,700	$147,500	$104,000
Number of structures potentially damaged by a **Category 2** hurricane	166	38	94	26	112
Potential property loss by a **Category 2** hurricane	$15,089,400	$2,952,600	$7,679,800	$3,835,000	$11,648,000
Percent of Total Structures potentially damaged by a **Category 2** hurricane	27.21%	8.05%	9.98%	11.02%	15.56%
Number of structures potentially damaged by a **Category 4** hurricane	188	60	171	47	313
Potential property loss by a **Category 4** hurricane	$17,089,200	$4,662,000	$13,970,700	$6,932,500	$32,552,000
Percent of Total Structures potentially damaged by a **Category 4** hurricane	30.82%	12.71%	18.15%	19.92%	43.47%

Table 12 B: Middlesex County Hurricane Surge Vulnerability

	Block Group 1, Census Tract 9511, Middlesex County, Virginia	Block Group 2, Census Tract 9511, Middlesex County, Virginia	Block Group 3, Census Tract 9511, Middlesex County, Virginia	Block Group 1, Census Tract 9512, Middlesex County, Virginia	Block Group 2, Census Tract 9512, Middlesex County, Virginia
Land Area (square meters)	21,014,374	15,333,877	23,749,158	23,554,424	10,300,950
Total population: Census 2000	982	716	816	1266	1071
Housing units: Total	580	477	386	930	1088
Total number of structures (based on E911 GIS data)	675	504	482	930	1262
Median value of owner-occupied housing from Census 2000 (H085001)	$96,900	$86,400	$139,500	$128,800	$160,800
Number of structures potentially damaged by a **Category 2** hurricane	113	73	4	214	351
Potential property loss by a **Category 2** hurricane	$10,949,700	$6,307,200	$558,000	$27,563,200	$56,440,800
Percent of Total Structures potentially damaged by a **Category 2** hurricane	16.74%	14.48%	0.83%	23.01%	27.81%
Number of structures potentially damaged by a **Category 4** hurricane	146	109	28	315	710
Potential property loss by a **Category 4** hurricane	$14,147,400	$9,417,600	$3,906,000	$40,572,000	$114,168,000
Percent of Total Structures potentially damaged by a **Category 4** hurricane	21.63%	21.63%	5.81%	33.87%	56.26%

Table 12 C: Middlesex County Hurricane Surge Vulnerability

	Block Group 2, Census Tract 9510, Urbanna, Virginia	**Middlesex totals:**	**Urbanna totals:**
Land Area (square meters)		**337,470,952**	
Total population: Census 2000	554	**9932**	**554**
Housing units: Total	349	**6362**	**349**
Total number of structures (based on E911 GIS data)	436	**6833**	**436**
Median value of owner-occupied housing from Census 2000 (H085001)	$140,100		
Number of structures potentially damaged by a **Category 2** hurricane	22	**1191**	**22**
Potential property loss by a **Category 2** hurricane	$3,082,200	**$143,023,700**	**$3,082,200**
Percent of Total Structures potentially damaged by a **Category 2** hurricane	5.05%	**17.43%**	**5.05%**
Number of structures potentially damaged by a **Category 4** hurricane	136	**2087**	**136**
Potential property loss by a **Category 4** hurricane	$19,053,600	**$257,417,400**	**$19,053,600**
Percent of Total Structures potentially damaged by a **Category 4** hurricane	31.19%	**30.54%**	**31.19%**

5.2. Coastal Flooding:

One of the most significant hazards potentially impacting localities within the Middle Peninsula is coastal flooding. A majority of flooding that affects the region is tidal flooding, which primarily occurs in conjunction with coastal storms such as hurricanes or nor'easters. Flooding can have a devastating effect on residential structures located within the Special Flood Hazard Area. Sections 5.2.1-5.2.9 illustrates an analysis of estimated total pre-firm structure value by SAFA zones: A, AE, and VE for census tract-block groups and locality totals.

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5.2.1. *Essex County*

ESSEX - all addr

Flood Ordinance Adopted in Essex County, September 14, 1982

Geography	Block Group Code	Total population: Census 2000 (P001001)	Total number of structures (based on E911 GIS data)	Median value of owner-occupied housing (H085001)	% of Housing units 1989 or earlier	Housing Units 1989 or earlier	Total SFHA structures within the Special Flood Hazard Area	TotaL Pre-Firm Structures in SFHA	Total Value of Pre-Firm Strucutres in SFHA	Number of structures in Flood **Zone A**	Percent of Total	estimated pre-FIRM structures in Flood **Zone A**	estimated total value of pre-FIRM structures in Flood **Zone A**	Number of structures in Flood **Zone AE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone AE**	estimated total value of pre-FIRM structures in Flood **Zone AE**	Number of structures in Flood **Zone VE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone VE**	estimated total value of pre-FIRM structures in Flood **Zone VE**
Block Group 1, Census Tract 9506, Essex County, Virginia	9506, 1	1360	906	$70,800	49.73%	451	24	13	$920,400	5	0.55%	3	$212,400	19	2.10%	10	$708,000	0	0.00%	0	$0
Block Group 2, Census Tract 9506, Essex County, Virginia	9506, 2	1270	793	$94,500	48.18%	382	97	48	$4,536,000	1	0.13%	1	$94,500	96	12.11%	47	$4,441,500	0	0.00%	0	$0
Block Group 3, Census Tract 9506, Essex County, Virginia	9506, 3	946	656	$93,600	68.47%	449	1	1	$93,600	1	0.15%	1	$93,600	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 1, Census Tract 9507, Essex County, Virginia	9507, 1	1055	974	$161,700	39.83%	388	77	31	$5,012,700	0	0.00%	0	$0	77	7.91%	31	$5,012,700	0	0.00%	0	$0
Block Group 2, Census Tract 9507, Essex County, Virginia	9507, 2	1421	799	$71,100	50.73%	405	1	1	$71,100	0	0.00%	0	$0	1	0.13%	1	$71,100	0	0.00%	0	$0
Block Group 3, Census Tract 9507, Essex County, Virginia	9507, 3	1015	548	$85,200	64.35%	353	1	1	$85,200	0	0.00%	0	$0	1	0.18%	1	$85,200	0	0.00%	0	$0
Block Group 1, Census Tract 9508, Essex County, Virginia	9508, 1	1229	884	$104,400	41.62%	368	125	53	$5,533,200	2	0.23%	1	$104,400	123	13.91%	52	$5,428,800	0	0.00%	0	$0
Block Group 2, Census Tract 9508, Essex County, Virginia	9508, 2	1062	766	$82,600	42.97%	329	41	18	$1,486,800	0	0.00%	0	$0	41	5.35%	18	$1,486,800	0	0.00%	0	$0
Block Group 3, Census Tract 9508, Essex County, Virginia	9508, 3	631	507	$82,700	71.10%	360	17	13	$1,075,100	0	0.00%	0	$0	17	3.35%	13	$1,075,100	0	0.00%	0	$0
					53.00%	**3485**	**384**	**179**	**$18,814,100**			0									
Block Group 1, Census Tract 9507, Tappahannock, Virginia	9507, 1		552	$93,900	81.56%	450	9	8	$751,200	0	0.00%	0	$0	9	1.63%	8	$751,200	0	0.00%	0	$0
Block Group 2, Census Tract 9507, Tappahannock, Virginia	9507, 2		301	$93,900	81.56%	246	0	0	$0	0	0.00%	0	$0	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 3, Census Tract 9507, Tappahannock, Virginia	9507, 3		547	$93,900	81.56%	446	1	1	$93,900	0	0.00%	0	$0	1	0.18%	1	$93,900	0	0.00%	0	$0
Essex totals:		**9989**	**6833**		**53.00%**	**3485**	**384**	**179**	**$18,814,100.00**	**9**	**0.13%**	**6**	**$504,900**	**375**	**5.49%**	**173**	**$18,309,200**	**0**	**0.00%**	**0**	**$0**
Tappahannock totals:		**2055**	**1400**		**81.56%**	**1142**	**10**	**9**	**$845,100.00**	**0**	**0.00%**	**0**	**0**	**10**	**0.71%**	**9**	**$845,100**	**0**	**0.00%**	**0**	**$0**

	Essex
Total Number of Structures	6833
% of Housing Units Pre-1989	53%
# Housing Units Pre-1989	3,485
Total Pre-Firm Structures in SFHA	179
Total Value of Pre-Firm Structures in SFHA	$ 18,814,100

5.2.2. *Town of Tappahannock*

Flood Ordinance Adopted in Essex County, September 14, 1982

ESSEX - all addr

Geography	Block Group Code	Total population: Census 2000 (P001001)	Total number of structures (based on E911 GIS data)	Median value of owner-occupied housing (H085001)	% of Housing units 1989 or earlier	Housing Units 1989 or earlier	Total SFHA structures within the Special Flood Hazard Area	TotaL Pre-Firm Structures in SFHA	Total Value of Pre-Firm Strucutres in SFHA	Number of structures in Flood **Zone A**	Percent of Total	estimated pre-FIRM structures in Flood **Zone A**	estimated total value of pre-FIRM structures in Flood **Zone A**	Number of structures in Flood **Zone AE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone AE**	estimated total value of pre-FIRM structures in Flood **Zone AE**	Number of structures in Flood **Zone VE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone VE**	estimated total value of pre-FIRM structures in Flood **Zone VE**
Block Group 1, Census Tract 9506, Essex County, Virginia	9506, 1	1360	906	$70,800	49.73%	451	24	13	$920,400	5	0.55%	3	$212,400	19	2.10%	10	$708,000	0	0.00%	0	$0
Block Group 2, Census Tract 9506, Essex County, Virginia	9506, 2	1270	793	$94,500	48.18%	382	97	48	$4,536,000	1	0.13%	1	$94,500	96	12.11%	47	$4,441,500	0	0.00%	0	$0
Block Group 3, Census Tract 9506, Essex County, Virginia	9506, 3	946	656	$93,600	68.47%	449	1	1	$93,600	1	0.15%	1	$93,600	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 1, Census Tract 9507, Essex County, Virginia	9507, 1	1055	974	$161,700	39.83%	388	77	31	$5,012,700	0	0.00%	0	$0	77	7.91%	31	$5,012,700	0	0.00%	0	$0
Block Group 2, Census Tract 9507, Essex County, Virginia	9507, 2	1421	799	$71,100	50.73%	405	1	1	$71,100	0	0.00%	0	$0	1	0.13%	1	$71,100	0	0.00%	0	$0
Block Group 3, Census Tract 9507, Essex County, Virginia	9507, 3	1015	548	$85,200	64.35%	353	1	1	$85,200	0	0.00%	0	$0	1	0.18%	1	$85,200	0	0.00%	0	$0
Block Group 1, Census Tract 9508, Essex County, Virginia	9508, 1	1229	884	$104,400	41.62%	368	125	53	$5,533,200	2	0.23%	1	$104,400	123	13.91%	52	$5,428,800	0	0.00%	0	$0
Block Group 2, Census Tract 9508, Essex County, Virginia	9508, 2	1062	766	$82,600	42.97%	329	41	18	$1,486,800	0	0.00%	0	$0	41	5.35%	18	$1,486,800	0	0.00%	0	$0
Block Group 3, Census Tract 9508, Essex County, Virginia	9508, 3	631	507	$82,700	71.10%	360	17	13	$1,075,100	0	0.00%	0	$0	17	3.35%	13	$1,075,100	0	0.00%	0	$0
					53.00%	**3485**	**384**	**179**	**$18,814,100**			0									
Block Group 1, Census Tract 9507, Tappahannock, Virginia	9507, 1		552	$93,900	81.56%	450	9	8	$751,200	0	0.00%	0	$0	9	1.63%	8	$751,200	0	0.00%	0	$0
Block Group 2, Census Tract 9507, Tappahannock, Virginia	9507, 2		301	$93,900	81.56%	246	0	0	$0	0	0.00%	0	$0	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 3, Census Tract 9507, Tappahannock, Virginia	9507, 3		547	$93,900	81.56%	446	1	1	$93,900	0	0.00%	0	$0	1	0.18%	1	$93,900	0	0.00%	0	$0
Essex totals:		**9989**	**6833**		**53.00%**	**3485**	**384**	**179**	**$18,814,100.00**	**9**	**0.13%**	**6**	**$504,900**	**375**	**5.49%**	**173**	**$18,309,200**	**0**	**0.00%**	**0**	**$0**
Tappahannock totals:		**2055**	**1400**		**81.56%**	**1142**	**10**	**9**	**$845,100.00**	**0**	**0.00%**	**0**	**0**	**10**	**0.71%**	**9**	**$845,100**	**0**	**0.00%**	**0**	**$0**

	Tappahannock
Total Number of Structures	1400
% of Housing Units Pre-1989	81.56%
# Housing Units Pre-1989	1,142
Total Pre-Firm Structures in SFHA	9
Total Value of Pre-Firm Structures in SFHA	$ 845,100

5.2.3. *Gloucester County*

GLOUCESTER **Flood Ordinance Adopted in Gloucester July 7, 1987**

Geography	Block Group Code	Total population: Census 2000 (P001001)	Total number of structures (based on E911 GIS data)	Median value of owner-occupied housing (H085001)	% of Housing units 1989 or earlier	Housing Units 1989 or earlier	Total SFHA structures within the Special Flood Hazard Area	TotaL Pre-Firm Structures in SFHA	Total Value of Pre-Firm Strucutres in SFHA	Number of structures in Flood **Zone A**	Percent of Total	estimated pre-FIRM structures in Flood **Zone A**	estimated total value of pre-FIRM structures in Flood **Zone A**	Number of structures in Flood **Zone AE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone AE**	estimated total value of pre-FIRM structures in Flood **Zone AE**	Number of structures in Flood **Zone VE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone VE**	estimated total value of pre-FIRM structures in Flood **Zone VE**
Block Group 1, Census Tract 1001, Gloucester County, Virginia	1001, 1	2421	1171	$97,100	62.67%	734	48	31	$3,010,100	1	0.09%	1	$97,100	47	4.01%	30	$2,913,000	0	0.00%	0	$0
Block Group 2, Census Tract 1001, Gloucester County, Virginia	1001, 2	4216	1834	$85,700	72.03%	1321	97	71	$6,084,700	1	0.05%	1	$85,700	96	5.23%	70	$5,999,000	0	0.00%	0	$0
Block Group 1, Census Tract 1002, Gloucester County, Virginia	1002, 1	3133	1438	$113,500	58.97%	848	90	54	$6,129,000	5	0.35%	3	$340,500	85	5.91%	51	$5,788,500	0	0.00%	0	$0
Block Group 2, Census Tract 1002, Gloucester County, Virginia	1002, 2	1110	615	$142,200	93.64%	576	211	199	$28,297,800	0	0.00%	0	$0	196	31.87%	184	$26,164,800	15	2.44%	15	$2,133,000
Block Group 3, Census Tract 1002, Gloucester County, Virginia	1002, 3	1021	484	$120,300	83.54%	404	71	60	$7,218,000	0	0.00%	0	$0	67	13.84%	56	$6,736,800	4	0.83%	4	$481,200
Block Group 4, Census Tract 1002, Gloucester County, Virginia	1002, 4	1966	789	$117,400	81.51%	643	6	5	$587,000	6	0.76%	5	$587,000	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 5, Census Tract 1002, Gloucester County, Virginia	1002, 5	1681	837	$100,600	84.59%	708	7	7	$704,200	6	0.72%	6	$603,600	1	0.12%	1	$100,600	0	0.00%	0	$0
Block Group 6, Census Tract 1002, Gloucester County, Virginia	1002, 6	2972	1103	$109,200	81.31%	897	10	9	$982,800	0	0.00%	0	$0	10	0.91%	9	$982,800	0	0.00%	0	$0
Block Group 1, Census Tract 1003, Gloucester County, Virginia	1003, 1	2777	1147	$114,100	77.54%	889	60	47	$5,362,700	0	0.00%	0	$0	60	5.23%	47	$5,362,700	0	0.00%	0	$0
Block Group 2, Census Tract 1003, Gloucester County, Virginia	1003, 2	1782	693	$91,200	76.84%	533	8	7	$638,400	0	0.00%	0	$0	8	1.15%	7	$638,400	0	0.00%	0	$0
Block Group 3, Census Tract 1003, Gloucester County, Virginia	1003, 3	1509	618	$89,200	75.97%	470	6	5	$446,000	0	0.00%	0	$0	6	0.97%	5	$446,000	0	0.00%	0	$0
Block Group 4, Census Tract 1003, Gloucester County, Virginia	1003, 4	1967	656	$111,400	90.22%	592	38	35	$3,899,000	0	0.00%	0	$0	38	5.79%	35	$3,899,000	0	0.00%	0	$0
Block Group 5, Census Tract 1003, Gloucester County, Virginia	1003, 5	1673	658	$118,700	92.70%	610	10	10	$1,187,000	0	0.00%	0	$0	6	0.91%	6	$712,200	4	0.61%	4	$474,800
Block Group 6, Census Tract 1003, Gloucester County, Virginia	1003, 6	1184	565	$123,700	85.99%	486	56	49	$6,061,300	0	0.00%	0	$0	52	9.20%	45	$5,566,500	4	0.71%	4	$494,800
Block Group 1, Census Tract 1004, Gloucester County, Virginia	1004, 1	795	467	$124,400	75.12%	351	237	179	$22,267,600	0	0.00%	0	$0	223	47.75%	168	$20,899,200	14	3.00%	11	$1,368,400
Block Group 2, Census Tract 1004, Gloucester County, Virginia	1004, 2	689	387	$109,800	96.41%	373	216	209	$22,948,200	0	0.00%	0	$0	180	46.51%	174	$19,105,200	36	9.30%	35	$3,843,000
Block Group 1, Census Tract 1005, Gloucester County, Virginia	1005, 1	623	336	$79,000	95.50%	321	335	321	$25,359,000	0	0.00%	0	$0	211	62.80%	202	$15,958,000	124	36.90%	119	$9,401,000
Block Group 2, Census Tract 1005, Gloucester County, Virginia	1005, 2	648	315	$117,400	89.39%	282	228	205	$24,067,000	0	0.00%	0	$0	204	64.76%	183	$21,484,200	24	7.62%	22	$2,582,800
Block Group 3, Census Tract 1005, Gloucester County, Virginia	1005, 3	1642	715	$123,700	90.21%	645	173	157	$19,420,900	0	0.00%	0	$0	173	24.20%	157	$19,420,900	0	0.00%	0	$0
Block Group 4, Census Tract 1005, Gloucester County, Virginia	1005, 4	971	432	$102,800	88.86%	384	326	290	$29,812,000	0	0.00%	0	$0	324	75.00%	288	$29,606,400	2	0.46%	2	$205,600
Gloucester totals:			**15260**		**82.65%**	**12065**	**2233**	**1950**	**$214,482,700**	**19**	**0.12%**	**16**	**$1,713,900**	**1987**	**13.02%**	**1718**	**$191,784,200**	**227**	**1.49%**	**216**	**$20,984,600**

Total Number of Structures	15,260
% of Housing Units Pre-1989	82.65%
# Housing Units Pre-1989	12,065
Total Pre-Firm Structures in SFHA	1,950
Total Value of Pre-Firm Structures in SFHA	$ 214,482,700

5.2.4. *King and Queen County*

King &Queen All Habitable Structures:
Date Flood Ordinance adopted?

Geography	Block Group Code	Total population: Census 2000 (P001001)	Total number of structures (based on E911 GIS data)	Median value of owner-occupied housing (H085001)	% of Housing units 1989 or earlier	Housing Units 1989 or earlier	Total SFHA structures within the Special Flood Hazard Area	TotaL Pre-Firm Structures in SFHA	Total Value of Pre-Firm Strucutres in SFHA	Number of structures in Flood **Zone A**	Percent of Total	estimated pre-FIRM structures in Flood **Zone A**	estimated total value of pre-FIRM structures in Flood **Zone A**	Number of structures in Flood **Zone AE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone AE**	estimated total value of pre-FIRM structures in Flood **Zone AE**	Number of structures in Flood **Zone VE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone VE**	estimated total value of pre-FIRM structures in Flood **Zone VE**
Block Group 1, Census Tract 9504, King and Queen County, Virginia	9504, 1	2578	1146	$79,500	24.58%	282	7	2	$159,000	7	0.61%	2	$159,000	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 2, Census Tract 9504, King and Queen County, Virginia	9504, 2	1210	617	$88,600	49.64%	306	16	9	$797,400	13	2.11%	7	$620,200	3	0.49%	2	$177,200	0	0.00%	0	$0
Block Group 1, Census Tract 9505, King and Queen County, Virginia	9505, 1	1308	592	$87,200	47.12%	279	7	4	$348,800	1	0.17%	1	$87,200	6	1.01%	3	$261,600	0	0.00%	0	$0
Block Group 2, Census Tract 9505, King and Queen County, Virginia	9505, 2	630	335	$73,000	93.92%	315	11	11	$803,000	0	0.00%	0	$0	11	3.28%	11	$803,000	0	0.00%	0	$0
Block Group 3, Census Tract 9505, King and Queen County, Virginia	9505, 3	904	517	$76,300	64.20%	332	134	87	$6,638,100	0	0.00%	0	$0	134	25.92%	87	$6,638,100	0	0.00%	0	$0
King and Queen totals:		**6630**	**3207**		**55.89%**	**1513**	**175**	**113**	**$8,746,300**	**21**	**0.65%**	**10**	**$866,400**	**154**	**4.80%**	**103**	**$7,879,900**	**0**	**0.00%**	**0**	**$0**

Total Number of Structures	3207
% of Housing Units Pre-1989	55.89%
# Housing Units Pre-1989	1,513
Total Pre-Firm Structures in SFHA	113
Total Value of Pre-Firm Structures in SFHA	$ 8,746,300

5.2.5. *King William County*

Flood Ordinance Adopted in King William in 1987 (King William County Code, Chapter 38)

King William

Geography	Block Group Code	Total population: Census 2000 (P001001)	Total number of structures (based on E911 GIS data)	Median value of owner-occupied housing (H085001)	% of Housing units 1989 or earlier	Housing Units 1989 or earlier	Total SFHA structures within the Special Flood Hazard Area	TotaL Pre-Firm Structures in SFHA	Total Value of Pre-Firm Strucutres in SFHA	Number of structures in Flood **Zone A**	Percent of Total	estimated pre-FIRM structures in Flood **Zone A**	estimated total value of pre-FIRM structures in Flood **Zone A**	Number of structures in Flood **Zone AE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone AE**	estimated total value of pre-FIRM structures in Flood **Zone AE**	Number of structures in Flood **Zone VE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone VE**	estimated total value of pre-FIRM structures in Flood **Zone VE**
Block Group 1, Census Tract 9501, King William County, Virginia	9501, 1	1107	508	$145,400	62.61%	318	6	4	$581,600	6	1.18%	4	$581,600	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 2, Census Tract 9501, King William County, Virginia	9501, 2	2022	797	$109,000	37.87%	302	1	1	$109,000	1	0.13%	1	$109,000	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 3, Census Tract 9501, King William County, Virginia	9501, 3	2740	1120	$102,800	26.76%	300	11	3	$308,400	11	0.98%	3	$308,400	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 4, Census Tract 9501, King William County, Virginia	9501, 4	2453	1054	$98,500	28.99%	306	5	3	$295,500	1	0.09%	1	$98,500	4	0.38%	2	$197,000	0	0.00%	0	$0
Block Group 1, Census Tract 9502, King William County, Virginia	9502, 1	720	377	$95,600	86.07%	324	24	21	$2,007,600	16	4.24%	14	$1,338,400	8	2.12%	7	$669,200	0	0.00%	0	$0
Block Group 2, Census Tract 9502, King William County, Virginia	9502, 2	1171	549	$113,700	55.27%	303	4	3	$341,100	0	0.00%	0	$0	4	0.73%	3	$341,100	0	0.00%	0	$0
Block Group 1, Census Tract 9503, King William County, Virginia	9503, 1	1758	52	$112,500	40.82%	21	8	4	$450,000	0	0.00%	0	$0	8	15.38%	4	$450,000	0	0.00%	0	$0
Block Group 2, Census Tract 9503, King William County, Virginia	9503, 2	1175	0	$85,900	54.94%	0	0	0	$0	0	0.00%	0	$0	0	0.00%	0	$0	0	0.00%	0	$0
					49.17%	**1874**	**59**	**39**	**$4,093,200**												
Block Group 1, Census Tract 9503,West Point, Virginia	9503, 1		1045	$96,700	87.35%	913	79	70	$6,769,000	0	0.00%	0	$0	79	7.56%	70	$6,769,000	0	0.00%	0	$0
Block Group 2, Census Tract 9503, West Point, Virginia	9503, 2		947	$96,700	87.35%	827	138	121	$11,700,700	0	0.00%	0	$0	138	14.57%	121	$11,700,700	0	0.00%	0	$0
							0														
							0														
King William totals:		**13146**	**4457**		**49.17%**	**1874**	**59**	**39**	**$4,093,200**	**35**	**0.79%**	**23**	**$2,435,900**	**24**	**0.54%**	**16**	**$1,657,300**	**0**	**0.00%**	**0**	**$0**
West Point totals:		**2906**	**1992**		**87.35%**	**1740**	**217**	**191**	**$18,469,700**	**0**	**0.00%**	**0**	**$0**	**217**	**10.89%**	**191**	**$18,469,700**	**0**	**0.00%**	**0**	**$0**

	King William
Total Number of Structures	4457
% of Housing Units Pre-1989	49.17%
# Housing Units Pre-1989	1,874
Total Pre-Firm Structures in SFHA	39
Total Value of Pre-Firm Structures in SFHA	$ 4,093,200

5.2.6. *Town of West Point*

King William

Flood Ordinance Adopted in King William in 1987 (King William County Code, Chapter 38)

Geography	Block Group Code	Total population: Census 2000 (P001001)	Total number of structures (based on E911 GIS data)	Median value of owner-occupied housing (H085001)	% of Housing units 1989 or earlier	Housing Units 1989 or earlier	Total SFHA structures within the Special Flood Hazard Area	TotaL Pre-Firm Structures in SFHA	Total Value of Pre-Firm Strucutres in SFHA	Number of structures in Flood **Zone A**	Percent of Total	estimated pre-FIRM structures in Flood **Zone A**	estimated total value of pre-FIRM structures in Flood **Zone A**	Number of structures in Flood **Zone AE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone AE**	estimated total value of pre-FIRM structures in Flood **Zone AE**	Number of structures in Flood **Zone VE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone VE**	estimated total value of pre-FIRM structures in Flood **Zone VE**
Block Group 1, Census Tract 9501, King William County, Virginia	9501, 1	1107	508	$145,400	62.61%	318	6	4	$581,600	6	1.18%	4	$581,600	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 2, Census Tract 9501, King William County, Virginia	9501, 2	2022	797	$109,000	37.87%	302	1	1	$109,000	1	0.13%	1	$109,000	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 3, Census Tract 9501, King William County, Virginia	9501, 3	2740	1120	$102,800	26.76%	300	11	3	$308,400	11	0.98%	3	$308,400	0	0.00%	0	$0	0	0.00%	0	$0
Block Group 4, Census Tract 9501, King William County, Virginia	9501, 4	2453	1054	$98,500	28.99%	306	5	3	$295,500	1	0.09%	1	$98,500	4	0.38%	2	$197,000	0	0.00%	0	$0
Block Group 1, Census Tract 9502, King William County, Virginia	9502, 1	720	377	$95,600	86.07%	324	24	21	$2,007,600	16	4.24%	14	$1,338,400	8	2.12%	7	$669,200	0	0.00%	0	$0
Block Group 2, Census Tract 9502, King William County, Virginia	9502, 2	1171	549	$113,700	55.27%	303	4	3	$341,100	0	0.00%	0	$0	4	0.73%	3	$341,100	0	0.00%	0	$0
Block Group 1, Census Tract 9503, King William County, Virginia	9503, 1	1758	52	$112,500	40.82%	21	8	4	$450,000	0	0.00%	0	$0	8	15.38%	4	$450,000	0	0.00%	0	$0
Block Group 2, Census Tract 9503, King William County, Virginia	9503, 2	1175	0	$85,900	54.94%	0	0	0	$0	0	0.00%	0	$0	0	0.00%	0	$0	0	0.00%	0	$0
					49.17%	**1874**	**59**	**39**	**$4,093,200**												
Block Group 1, Census Tract 9503,West Point, Virginia	9503, 1		1045	$96,700	87.35%	913	79	70	$6,769,000	0	0.00%	0	$0	79	7.56%	70	$6,769,000	0	0.00%	0	$0
Block Group 2, Census Tract 9503, West Point, Virginia	9503, 2		947	$96,700	87.35%	827	138	121	$11,700,700	0	0.00%	0	$0	138	14.57%	121	$11,700,700	0	0.00%	0	$0
							0														
							0														
King William totals:		**13146**	**4457**		**49.17%**	**1874**	**59**	**39**	**$4,093,200**	**35**	**0.79%**	**23**	**$2,435,900**	**24**	**0.54%**	**16**	**$1,657,300**	**0**	**0.00%**	**0**	**$0**
West Point totals:		**2906**	**1992**		**87.35%**	**1740**	**217**	**191**	**$18,469,700**	**0**	**0.00%**	**0**	**$0**	**217**	**10.89%**	**191**	**$18,469,700**	**0**	**0.00%**	**0**	**$0**

	West Point
Total Number of Structures	1992
% of Housing Units Pre-1989	87.35%
# Housing Units Pre-1989	1,740
Total Pre-Firm Structures in SFHA	191
Total Value of Pre-Firm Structures in SFHA	$ 18,469,700

5.2.7. Mathews County:

Data Based on E911 Structure Database, 2004

MATHEWS

Flood Ordinance Adopted in Mathews April 28, 1987

Geography	Block Group Code	Total population: Census 2000 (P001001)	Total number of structures (based on E911 GIS data)	Median value of owner-occupied housing (H085001)	% of Housing units 1989 or earlier	Housing Units 1989 or earlier	Total structures within the Special Flood Hazard Area	TotaL Pre-Firm Structures in SFHA	Total Value of Pre-Firm Strucutres in SFHA	Number of structures in Flood **Zone A**	Percent of Total	estimated pre-FIRM structures in Flood **Zone A**	estimated total value of pre-FIRM structures in Flood **Zone A**	Number of structures in Flood **Zone AE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone AE**	estimated total value of pre-FIRM structures in Flood **Zone AE**	Number of structures in Flood **Zone VE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone VE**	estimated total value of pre-FIRM structures in Flood **Zone VE**
Block Group 1, Census Tract 9513, Mathews County, Virginia	9513, 1	705	665	$92,600	81.94%	545	488	401	$37,132,600	0	0.00%	0	$0	448	67.37%	368	$34,076,800	40	6.02%	33	$3,055,800
Block Group 2, Census Tract 9513, Mathews County, Virginia	9513, 2	3705	2093	$131,500	78.93%	1652	509	402	$52,863,000	0	0.00%	0	$0	442	21.12%	349	$45,893,500	67	3.20%	53	$6,969,500
Block Group 1, Census Tract 9514, Mathews County, Virginia	9514, 1	3260	1923	$102,000	77.99%	1500	859	671	$68,442,000	0	0.00%	0	$0	812	42.23%	634	$64,668,000	47	2.44%	37	$3,774,000
Block Group 2, Census Tract 9514, Mathews County, Virginia	9514, 2	1537	951	$105,000	89.67%	853	779	700	$73,500,000	0	0.00%	0	$0	722	75.92%	648	$68,040,000	57	5.99%	52	$5,460,000
Mathews totals:			**5632**		**82.13%**	**4626**	**2635**	**2174**	**$231,937,600**	**0**	**0.00%**	**0**		**2424**	**43.04%**	**1999**	**$212,678,300**	**211**	**3.75%**	**175**	**$19,259,300**

Total Number of Structures	5,632
% of Housing Units Pre-1989	82.13%
# Housing Units Pre-1989	4,626
Total Pre-Firm Structures in SFHA	2,174
Total Value of Pre-Firm Structures in SFHA	$ 231,937,007

5.2.8. Middlesex County:

Middlesex	Geography	Block Group Code	Total population: Census 2000 (P001001)	Total number of structures (based on E911 GIS data)	Median value of owner-occupied housing (H085001)	% of Housing units 1989 or earlier	Housing Units 1989 or earlier	Total SFHA structures within the Special Flood Hazard Area	TotaL Pre-Firm Structures in SFHA	Total Value of Pre-Firm Strucutres in SFHA	Number of structures in Flood **Zone A**	Percent of Total	estimated pre-FIRM structures in Flood **Zone A**	estimated total value of pre-FIRM structures in Flood **Zone A**	Number of structures in Flood **Zone AE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone AE**	estimated total value of pre-FIRM structures in Flood **Zone AE**	Number of structures in Flood **Zone VE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone VE**	estimated total value of pre-FIRM structures in Flood **Zone VE**
	Block Group 1, Census Tract 9509, Middlesex County, Virginia	9509, 1	786	610	$90,900	51.87%	316	53	28	$2,545,200	0	0.00%	0	$0	53	8.69%	28	$2,545,200	0	0.00%	0	$0
	Block Group 2, Census Tract 9509, Middlesex County, Virginia	9509, 2	775	472	$77,700	67.15%	317	17	12	$932,400	7	1.48%	5	$388,500	10	2.12%	7	$543,900	0	0.00%	0	$0
	Block Group 1, Census Tract 9510, Middlesex County, Virginia	9510, 1	1530	942	$81,700	37.72%	355	52	20	$1,634,000	0	0.00%	0	$0	52	5.52%	20	$1,634,000	0	0.00%	0	$0
	Block Group 2, Census Tract 9510, Middlesex County, Virginia	9510, 2	947	236	$147,500	49.29%	116	12	6	$885,000	0	0.00%	0	$0	12	5.08%	6	$885,000	0	0.00%	0	$0
	Block Group 3, Census Tract 9510, Middlesex County, Virginia	9510, 3	1043	720	$104,000	42.77%	308	67	29	$3,016,000	0	0.00%	0	$0	67	9.31%	29	$3,016,000	0	0.00%	0	$0
	Block Group 1, Census Tract 9511, Middlesex County, Virginia	9511, 1	982	675	$96,900	47.93%	324	4	2	$193,800	0	0.00%	0	$0	4	0.59%	2	$193,800	0	0.00%	0	$0
	Block Group 2, Census Tract 9511, Middlesex County, Virginia	9511, 2	716	504	$86,400	58.28%	294	46	28	$2,419,200	0	0.00%	0	$0	40	7.94%	24	$2,073,600	6	1.19%	4	$345,600
	Block Group 3, Census Tract 9511, Middlesex County, Virginia	9511, 3	816	482	$139,500	72.02%	347	8	6	$837,000	0	0.00%	0	$0	8	1.66%	6	$837,000	0	0.00%	0	$0
	Block Group 1, Census Tract 9512, Middlesex County, Virginia	9512, 1	1266	930	$128,800	29.89%	278	48	15	$1,932,000	0	0.00%	0	$0	42	4.52%	13	$1,674,400	6	0.65%	2	$257,600
	Block Group 2, Census Tract 9512, Middlesex County, Virginia	9512, 2	1071	1262	$160,800	25.55%	322	376	97	$15,597,600	0	0.00%	0	$0	313	24.80%	80	$12,864,000	63	4.99%	17	$2,733,600
						48.25%	**2978**	**683**	**243**	**$29,992,200**												
	Block Group 2, Census Tract 9510, Urbanna, Virginia	9510, 2	554	436	$140,100	87.97%	384	28	25	$3,502,500	0	0.00%	0	$0	28	6.42%	25	$3,502,500	0	0.00%	0	$0
	Middlesex totals:		**9932**	**6833**		**48.25%**	**2978**	**683**	**243**	**$29,992,200**	**7**	**0.10%**	**5**	**$388,500**	**601**	**8.80%**	**215**	**$26,266,900**	**75**	**1.10%**	**23**	**$3,336,800**
	Urbanna totals		**554**	**436**		**87.97%**	**384**	**28**	**25**	**$3,502,500**	**0**	**0.00%**	**0**	**$0**	**28**	**6.42%**	**25**	**$3,502,500**	**0**	**0.00%**	**0**	**$0**

Total Number of Structures	6,833
% of Housing Units Pre-1989	48.25%
# Housing Units Pre-1989	2,978
Total Pre-Firm Structures in SFHA	243
Total Value of Pre-Firm Structures in SFHA	$ 29,992,200

5.2.9. Town of Urbanna:

	Geography	Block Group Code	Total population: Census 2000 (P001001)	Total number of structures (based on E911 GIS data)	Median value of owner-occupied housing (H085001)	% of Housing units 1989 or earlier	Housing Units 1989 or earlier	Total SFHA structures within the Special Flood Hazard Area	TotaL Pre-Firm Structures in SFHA	Total Value of Pre-Firm Strucutres in SFHA	Number of structures in Flood **Zone A**	Percent of Total	estimated pre-FIRM structures in Flood **Zone A**	estimated total value of pre-FIRM structures in Flood **Zone A**	Number of structures in Flood **Zone AE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone AE**	estimated total value of pre-FIRM structures in Flood **Zone AE**	Number of structures in Flood **Zone VE**	Percent of Total	estimated pre-FIRM structures in Flood **Zone VE**	estimated total value of pre-FIRM structures in Flood **Zone VE**
Middlesex	Block Group 1, Census Tract 9509, Middlesex County, Virginia	9509, 1	786	610	$90,900	51.87%	316	53	28	$2,545,200	0	0.00%	0	$0	53	8.69%	28	$2,545,200	0	0.00%	0	$0
	Block Group 2, Census Tract 9509, Middlesex County, Virginia	9509, 2	775	472	$77,700	67.15%	317	17	12	$932,400	7	1.48%	5	$388,500	10	2.12%	7	$543,900	0	0.00%	0	$0
	Block Group 1, Census Tract 9510, Middlesex County, Virginia	9510, 1	1530	942	$81,700	37.72%	355	52	20	$1,634,000	0	0.00%	0	$0	52	5.52%	20	$1,634,000	0	0.00%	0	$0
	Block Group 2, Census Tract 9510, Middlesex County, Virginia	9510, 2	947	236	$147,500	49.29%	116	12	6	$885,000	0	0.00%	0	$0	12	5.08%	6	$885,000	0	0.00%	0	$0
	Block Group 3, Census Tract 9510, Middlesex County, Virginia	9510, 3	1043	720	$104,000	42.77%	308	67	29	$3,016,000	0	0.00%	0	$0	67	9.31%	29	$3,016,000	0	0.00%	0	$0
	Block Group 1, Census Tract 9511, Middlesex County, Virginia	9511, 1	982	675	$96,900	47.93%	324	4	2	$193,800	0	0.00%	0	$0	4	0.59%	2	$193,800	0	0.00%	0	$0
	Block Group 2, Census Tract 9511, Middlesex County, Virginia	9511, 2	716	504	$86,400	58.28%	294	46	28	$2,419,200	0	0.00%	0	$0	40	7.94%	24	$2,073,600	6	1.19%	4	$345,600
	Block Group 3, Census Tract 9511, Middlesex County, Virginia	9511, 3	816	482	$139,500	72.02%	347	8	6	$837,000	0	0.00%	0	$0	8	1.66%	6	$837,000	0	0.00%	0	$0
	Block Group 1, Census Tract 9512, Middlesex County, Virginia	9512, 1	1266	930	$128,800	29.89%	278	48	15	$1,932,000	0	0.00%	0	$0	42	4.52%	13	$1,674,400	6	0.65%	2	$257,600
	Block Group 2, Census Tract 9512, Middlesex County, Virginia	9512, 2	1071	1262	$160,800	25.55%	322	376	97	$15,597,600	0	0.00%	0	$0	313	24.80%	80	$12,864,000	63	4.99%	17	$2,733,600
						48.25%	**2978**	**683**	**243**	**$29,992,200**												
	Block Group 2, Census Tract 9510, Urbanna, Virginia	9510, 2	554	436	$140,100	87.97%	384	28	25	$3,502,500	0	0.00%	0	$0	28	6.42%	25	$3,502,500	0	0.00%	0	$0
	Middlesex totals:		**9932**	**6833**		**48.25%**	**2978**	**683**	**243**	**$29,992,200**	**7**	**0.10%**	**5**	**$388,500**	**601**	**8.80%**	**215**	**$26,266,900**	**75**	**1.10%**	**23**	**$3,336,800**
	Urbanna totals		**554**	**436**		**87.97%**	**384**	**28**	**25**	**$3,502,500**	**0**	**0.00%**	**0**	**$0**	**28**	**6.42%**	**25**	**$3,502,500**	**0**	**0.00%**	**0**	**$0**

Total Number of Structures	436
% of Housing Units Pre-1989	87.97
# Housing Units Pre-1989	384
Total Pre-Firm Structures in SFHA	25
Total Value of Pre-Firm Structures in SFHA	$ 3,502,500

6. Capability Assessment

To further evaluate the potential for hazards to adversely affect the Middle Peninsula, the Risk Assessment and Mitigation Planning (RAMP) Committee conducted an inventory and analysis of the community's existing community assets, regulations, facilities, and mitigation capabilities. This capability assessment provides the community with a better understanding of its own preparedness levels and its capability to mitigate hazards. The results of this analysis should emphasize any areas where the community needs to improve its current strategies. The term "mitigation capabilities" covers a comprehensive review of all existing measures in place to help the Middle Peninsula mitigate or recover from the impacts of natural hazards.

6.1. Federal Regulations:

6.1.1. National Flood Insurance Program (NFIP)

Established in 1968, the NFIP provides flood insurance in communities that agree to regulate new development in identified Special Flood Hazard Areas (SFHAs) through the adoption and enforcement of a minimum Flood Damage Prevention Ordinance. It also requires, as a condition of every federally-backed mortgage within a SFHA, the purchase and maintenance of a flood insurance policy for the life of the loan. Each Middle Peninsula locality participates in the NFIP.

6.1.2. The Coastal Barrier Resources Act (CoBRA)

Established in 1972, the CoBRA is environmental legislation administered by the U.S. Fish and Wildlife Service. It provides for the identification and protection of Coastal Barrier Resources. IT prohibits the availability of federally-backed assistance including grants, loans, mortgages, and flood insurance within identified areas.

6.1.3. Coastal Zone Management Act (CZMA)

Established in 1972, and amended by the Coastal Zone Protection Act of 1996, the CZMA defines a nation al interest in the effective management, beneficial use, protection, and development of the Coastal Zone and identified the urgent need to protect this natural system from these competing interests. The CZMA encourages states to exercise their full authority over lands and waters of the Coastal Zone. Annual cost-share grants to states create and incentive to establish land-use and environmental protection standards that have served to reduce damage from coastal storms, as well as schieve its other multi-objective

goals, In Virginia, the Virginia Department of Environmental Quality (VDEQ) oversees the Virginia Coastal Resource Management Program.

6.2. State Capabilities:

6.2.1. VDEM's Emergency Operations Plan (January 2002) and Standard Hazard Mitigation Plan (September 2004)

The Virginia Department of Emergency Management (VDEM) has implemented several plans to help local governments deal with the effects of disasters. The Commonwealth of Virginia Emergency Operations Plan (State EOP) consists of a Basic Plan (Volume 1), a Recovery Plan (Volume 2), and other subplans addressing specific hazards. The Basic Plan describes the basic concepts of operation, assigns emergency response duties and responsibilities to departments and agencies, and includes an executive order from the Governor that promulgates the entire State EOP. The Commonwealth of Virginia Standard Hazard Mitigation Plan provides guidance for hazard mitigation within the Commonwealth. Its vision is supported by goals, objectives and strategies for Virginia state government that will reduce or prevent injury from natural hazards to citizens and critical state facilities.

6.2.2. Virginia's Bay Act Program

The Virginia General Assembly enacted the Chesapeake Bay Preservation Act in 1988. The Act is a critical element of Virginia's multifaceted response to the Chesapeake Bay Agreement. The Bay Act Program is designed to improve water quality in the Chesapeake Bay and its tributaries by requiring the use of effective conservation planning and pollution prevention practices when using and developing environmentally sensitive lands. Virginia Chesapeake Bay Regulations require communities east of Interstate 95 (the "Tidewater area of Virginia") regulate and enforce the use of two types of land features: Resource Protection Areas (RPAs), those that protect and benefit water quality; and Resource Management Areas (RMAs), those that have the potential to damage water quality. By carefully managing land uses within these areas, local governments help reduce the water quality impacts of nonpoint source pollution and improve the health of the Chesapeake Bay. The RPA significantly assists floodplain management because it requires that for any new development with the RPA, the owner must maintain a 100-foot setback buffer from the water line of any perennial stream as defined by the regulations. This includes all tidal water bodies in the Middle Peninsula. All Middle Peninsula localities comply with the Chesapeake Bay regulations as presently enacted.

6.2.3. Virginia Emergency Alert Systems (EAS) Stations

The EAS Stations are AM/FM radio stations that provide updated disaster and directional information. There are several radio stations that cover fourteen regions of the state, including an eastern Virginia and Richmond extended area region.

6.3. Community Capabilities

The localities of the Middle Peninsula each have a range of guidance documents and plans to help guide community planning and development, including Comprehensive Plans and Emergency Operations Plans. Middle Peninsula localities use building codes, zoning ordinances, subdivision ordinances, and various planning strategies to address how and where development occurs. Much of the information in the following sections has been derived from these documents.

6.3.1. Community-Specific Assets and Critical Facilities:

6.3.1.1. *Essex County and the Town of Tappahannock*

Fire and Rescue: Essex County is served by a single volunteer organization, the Tappahannock-Essex County Volunteer Fire Department from a new facility in Tappahannock. The Department of more than 50 members is equipped with a 250 gallon mimi-pumper, two 500 gallon pumpers, two tankers, and a portable pump. Traveling as far as 21 miles to either end of the County, with one satellite station at Center Cross and one at the northern end of the County, the fire department consistently averages about 20 calls per month throughout the year (Essex County Comprehensive Plan, 2003). The County-Town Rescue Squad operates four rescue vehicles and a boat and has over 35 members. Office records show an average of 50 calls per month during recent years. Units are dispatched county-wide from the Sheriff's Department. The County is also served by two private ambulance companies who provide backup for the volunteer squad.

Law Enforcement: The Essex County Sheriff's Department is located in Tappahannock and staffed by the Sheriff and ten officers. The department coordinates with other neighboring counties in minimum classroom on-the-job training and in emergency services operations. The Town employs an additional ten officers through its police department and five state police are assigned to the Town/County area (Essex County Comprehensive Plan, 2003).

County Administration: The County administrative offices are located in Tappahannock in or adjacent to the County Courthouse The County employs a full-time building official-zoning administrator and an administrative staff. Public facilities are costly to provide and operate in a rural county. The problems are more pronounced due to a lower population and revenue and the lack of concentrated development pattern. People must travel further for services, or the services have to travel further to people. This is expensive and often results in decreased services (Essex County Comprehensive Plan, 2003).

Hospital and Health Services: Riverside Tappahannock Hospital, a 100-bed facility, is located in Tappahannock offers X-Ray, Nuclear Medicine, Laboratory,

Physical Therapy, and Respiratory Therapy Services. The Emergency Department is well-equipped to treat all injuries and is staffed 24 hours a day by and Emergency Room Physician (Essex County Comprehensive Plan, 2003).

Emergency Operations: Emergency Operations for Essex County are directed and controlled from the County Emergency Operations Center. Chain of command and emergency operations procedures to be followed during an emergency incident are described in detail in the County's Emergency Operations Plan. The Emergency Operations Plan also describes Hazard Mitigation responsibilities within the County. The Emergency Management Coordinator is charged with the overall responsibility of coordinating the development and implementation of hazard mitigation plans.

Schools: The Essex County School Board operates a consolidated public school system at three sites in Tappahannock: Essex High School, Essex Intermediate, and Essex Elementary.

Solid Waste: Waste Disposal and Collection in Essex County are carried out by the Virginia Peninsulas Public Service Authority (VPPSA), headquartered in Williamsburg. The Essex County Landfill has been closed and waste is transported to commercial landfills outside the County (Essex County Comprehensive Plan, 2003).

Water and Wastewater: The only public water and sewer facilities offered in Essex County are located in the Town of Tappahannock. The County owns two water systems at schools which are now no longer in use. Many private subdivisions have central water supplies owned and operated privately. The rest of the county residents are served by wells and on-site disposal (septic) systems (Essex County Comprehensive Plan, 2003).

Transportation and Evacuation Routes: The existing public road system consists of primary and secondary State roads. All inter-county traffic and much intra-county travel is dependent upon Routes 17 and 360 which connect Essex County to surrounding metropolitan areas. Route 17 has shown substantial increases in traffic volumes in recent years with the greatest increase attributable to truck traffic. Waterways and airport facility have played a minor role as alternate transportation modes. Tappahannock Air Service operates the airport located adjacent to the industrial area within the Town limits. Primarily, the facility is used by private individuals, transients for fuel stops, and local businesses and industries. The County has found that because the increased use of air transportation nationwide, improving airport facilities may be prompted to remain competitive in attracting industry and maintain the community's role as a commercial center for the region (Essex County Comprehensive Plan, 2003).

6.3.1.2. *Gloucester County*

Fire and Rescue: Gloucester is served by six fire and rescue companies throughout the County: Gloucester Volunteer Fire & Rescue at Stations 1, 4, and 6; and Abingdon Volunteer Fire & Rescue at Stations 2, 3, and 5.

In order to better serve and protect the residents of Gloucester County, the Abingdon Volunteer Fire Company and Abingdon Volunteer Rescue Squad have merged. The formation of Abingdon Volunteer Fire and Rescue Incorporated (AVFR) provides fire and rescue services for the southern third of Gloucester County, Virginia. AVFR consist of 3 stations which house 4 engines, 3 medics, 2 rescue trucks, 2 brush trucks, a boat, a utility truck and an EMS support vehicle. Along with the dedication and the motivation of the 80 men and women, AVFR is able to provide the most suitable and professional care possible. Of those 80 men and women, the Chief oversees the entire operation of Abingdon Volunteer Fire and Rescue Inc. Under him are two Assistant Chiefs. The Assistant Chief for Fire is overall responsible for the fire operations, apparatus, and equipment, ensuring that AVFR is ready and capable of extinguishing a fire when needed. The Assistant Chief of EMS is overall responsible for the EMS operations, apparatus and equipment, ensuring that AVFR personnel have the necessary tools to provide care for those in need of medical attention.

The Gloucester Volunteer Fire Department was founded in 1937 and was expanded in 1969 to include a volunteer rescue squad. The combined company continues to serve the community today with over 100 active members. Covering nearly 200 square miles in the northern portion of Gloucester County, , the three stations support nine engines, a medium rescue, five ambulances, two boats, and a Heavy and Tactical Rescue Trailer.

Law Enforcement: The Gloucester Sheriff's Office is a full service Accredited Agency and the primary Law Enforcement provider in the County. The Mission of the Sheriff's Office is to provide for Peace and Security of all residents and visitors. The responsibilities associated with this mission are many. They include enforcement of state, local, and federal laws, protect life and property and operate a secure and safe jail, identify criminal offenders and criminal activity and, where appropriate, to apprehend offenders and participate in subsequent court proceedings, reduce the opportunities for the commission of some crimes through preventive patrol and other measures, aid individuals who are in danger of physical harm, protect constitutional guarantees, facilitate the movement of people and vehicles, assist those who cannot care for themselves, resolve conflict, identify problems that are potentially serious law enforcement or government problems, create and maintain a feeling of security in the community, promote and preserve civil order, and generally assist citizens in urgent situations.

County Administration: Gloucester is governed by a seven-member Board of Supervisors who are elected to 4-year terms. The Board appoints a County Administrator who serves as the chief administrative officer of the County government. County offices and courts are housed in buildings located in the Courthouse area.

Medical care: Residents of the Middle Peninsula are served by Riverside Walter Reed Hospital. This 71-bed facility, located in Gloucester, provides 24- hour emergency care, coronary care, an intensive care unit, and a full range of family oriented health care services. Additional medical services are available at three Newport News hospitals, Williamsburg Community Hospital and Sentara Hampton General Hospital. With a total of 1,320 beds, these facilities offer a full range of acute care services that include emergency care, obstetrics, surgery and full diagnostic services. The Middle Peninsula's close proximity to Richmond also permits residents to utilize the Medical College of Virginia, an internationally known teaching medical center.

Emergency Operations: Gloucester County recently hired a full-time Emergency Management Coordinator to oversee the Emergency Operations of the County.

Schools: Gloucester Public Schools has 6 elementary schools, two middle schools and one high school, Gloucester High with vocational/technical programs.

Water, Wastewater, and Solid Waste: Gloucester County provides various public services and facilities for its residents, including water supply, sewage disposal, and solid waste disposal. IN July 1990, Gloucester began delivering surface water from the Beaverdam Reservoir and its associated water treatment plant. This system delivers water to Gloucester Courthouse and Gloucester Point. Gloucester is connected to the sewerage facilities of the Hampton Roads Sanitation District through a 30-inch force main under the York River and along Route 17 to the Courthouse Sanitary District Plant. Gloucester County participates in a regional solid waste management system that is operated by the Virginia Peninsulas Public Service Authority (VPPSA), headquartered in Williamsburg. Residents bring trash to convenience centers where trash is placed into steel containers. A landfill sites is operated at the northern end of the county off Route 17.

Transportation and Evacuation Routes: All inter-county traffic and much intra-county travel is dependent upon Route 17 which serves as a major connector between York County, Hampton, and Newport News and connects Gloucester County to northern and western metropolitan areas. Routes 14-3 connects Gloucester to Mathews County to the east and West Point and Interstate 64 to the West. Route 17 serves as a major evacuation route for communities to the south, and crosses the York River and the Coleman Bridge at Gloucester Point. The Coleman Bridge was widened to 4 lanes in 1996.

6.3.1.3. *King and Queen County*

Fire and Rescue: The County is served by 4 volunteer fire departments and 3 volunteer rescue squads. There are no paid fire or rescue squad personnel in any of the units. The West Point VRS is scaling back its operation in southern King and Queen County and the County will need to fill the anticipated gap in this service area. The Upper King and Queen County VRS covers the northern portion of our County as well as small portions of surrounding Essex, Caroline, and King William Counties as called upon.

Law Enforcement: On duty at all times, the King & Queen County Sheriff's Office has four principal duties: law enforcement within the county, civil processes, court security, and dispatching of emergency services. The County employs the Sheriff, 9.5 deputies and 6 dispatchers.

The County is almost 70-miles long which can greatly affect response time to an incident depending on where in the County the law enforcement personnel are situated when the 911 call come into the dispatch center. By working with the local emergency service units, neighboring counties, and various regional and state agencies, the Sheriff's Office works hard to ensure that King and Queen County is a safe and orderly place in which to live.

County Administration: The 5-member Board of Supervisors governs the county. The Board appointed County administrator serves as the County's CEO and CFO with the assistance of a small number of administrative staff. The Courthouse complex is located in the geographic center of the County.

Medical care: There are 3 volunteer rescue squads that serve King and Queen County residents. There are no hospitals located in the County and residents are transported to hospitals in Richmond, Fredericksburg, Tappahannock, Mechanicsville and Gloucester. There is one family practice doctor in the northern area of the County with an office located along Route 360.

Emergency Operations: The County implemented E-911 services on January 12, 2005. The Sheriff's Office serves as the dispatch center for fire, rescue and law enforcement calls. The County now also has a regional computer aided dispatch system in place with King William County, New Kent County and the Town of West Point. The County has updated its Emergency Operation Plan (EOP) with approval slated for April or May 2005. The Chair of the Board of Supervisors is the Director of Emergency Operations with the County Administrator serving under him/her as Coordinator of Emergency Operations. The County also has a Deputy Coordinator who serves the County in this capacity as a volunteer.

Schools: Central High Schools is located in the geographic center of the County just north of the courthouse and serves grades 8 –12. There are two lower grade schools in the County. The northern ones is located on Route 721 north of Route

360 at St. Stephens Church and the southern one is located on Route 14 in the area known as Shanghai located north of the Route 33 corridor. There are 303 students at the high school, 253 at the northern lower school and 297 at the southern grade school.

Solid Waste: The County is under contract with the Virginia Peninsula Public Service Authority to provide solid waste services to County residents. There are 4 transfer stations, called convenience centers, spread out throughout the County. Three of the four stations are located adjacent to old County closed landfills. The County does have a large regional landfill managed by BFI. It is located in the south-central portion of the County on Route 614 off of Route 14 in an area known as Little Plymouth.

Water and Wastewater: There are no public water or public sewer systems in the County. All homes and businesses are dependent on private wells and septic systems. This poses particular concerns during extended periods of power outages such as the County experienced during Hurricane Isabel in 2003.

Transportation and Evacuation Routes: State Routes 360 and 33 run in an east-west direction towards the northern and southern ends of the County respectfully. These roads are connected by State Route 14, which runs in a north-south direction. These roads constitute the primary routes used for people leaving or entering the County. However, local people take a variety of secondary roads to move in and out of the County.

6.3.1.4. *King William County*

Fire and Rescue: King William County is served by King William Fire and Rescue, Mangohick Fire Department, Walkerton Community Fire Association (King and Queen County), and Mattaponi Rescue. The West Point Fire Department also serves the County. King William Fire and Rescue (KWFR)quarters are located on U.S. 36, east of Central Garage. The service area covered by KWFR extends to SR 600 to the south and SR 610 to the north. KWFR also serves some of King and Queen County. The Mangohick Fire Department covers about 55 square miles in northwest (upper) King William County from quarters on Route 30 northwest of Central Garage. The Walkerton Community Fire Association (WCFA), located in the Town of Walkerton on the Mattaponi River in King and Queen County, serves the central area of King William and King and Queen Counties. The Department's coverage area runs from SR 626 at Jim Hall's Store to SR 600 at the VDOT Highway Office, and the area between the Mattaponi and Pamunkey Rivers. About 55% of the Department's calls are in King William County. The Mattaponi Rescue Squad keeps one ambulance at the WCFA, one on Route 30, and one at Curtis Mason's Shop (King William County Comprehensive Plan, 2003).

Law Enforcement: The King William County Sheriff's Office is responsible for the majority of law enforcement efforts in the County. The Department's headquarters are located in the King William County Courts Building in King William. The Sheriff's Department dispatches all fire and rescue in the County with the exception of West Point. The Sheriff's Department has placed great emphasis on updating and modernizing its office and procedures. The County recently started using enhanced 9-1-1 and will soon have wireless 9-1-1 capability (King William County Comprehensive Plan, 2003).

County Administration: The County administrative offices are located behind the historic Courthouse at 180 Horse Landing Road, off Route 30, in King William. There are eight public buildings owned by King William County in the King William complex. These buildings include: County Administration Building, Virginia Polytechnic Institute and State University (VPI-SU) Extension Building, Health Department Building, Historic King William Courthouse, Jury Room Building (old jail), Juvenile Probation Division Office, and a new Courts Building (located near the Administrative Building and opened in 2004) (King William County Comprehensive Plan, 2003).

Hospital and Health Services: Two medical clinics serve the County. As part of the Virginia Department of Health's Three Rivers Health District, the King William County Health Department offers an array of health services to local citizens. The Health Department offices are located near the County's Administrative Office Complex. There are no hospitals within King William County. Regional health care facilities that serve the County include: Riverside Hospitals in Gloucester and Tappahannock; Bon Secours Regional Medical Center in Hanover County; Williamsburg Community Hospital in Williamsburg; and The Medical College of Virginia and other medical facilities in the Richmond area (King William County Comprehensive Plan, 2003).

Emergency Operations: Emergency Operations for King William County are directed and controlled from the County Emergency Operations Center located in the King William County Administration Building. Chain of command and emergency operations procedures to be followed during an emergency incident are described in detail in the County's Emergency Operations Plan. The Emergency Operations Plan also describes Hazard Mitigation responsibilities within the County. The Coordinator of Emergency Services is charged with the overall responsibility of coordinating the development and implementation of hazard mitigation plans. The Plan also states that a public information program should be initiated to increase citizens' awareness of local hazards, what is being done to mitigate their effects, and what is expected of the citizens. It should provide them with mitigation measures they can take as individuals to protect themselves and their property from the effects of identified hazards.

Schools: King William High School (located along Route 30 near Central Garage), Acquinton Elementary School, Hamilton-Holmes Middle School, and

Cool Spring Primary School (all located along Route 30 near the Route 30 / State Route 618 intersection) are equipped to be used as public shelters in the event of an emergency.

Solid Waste: King William County participates in a regional solid waste management system that is operated by the Virginia Peninsulas Public Service Authority (VPPSA), headquartered in Williamsburg. Residents bring trash to three convenience centers (Epworth Road Convenience Center, Landfill Convenience Center on King William Highway (Route 30), VFW Road Convenience Center) and one transfer station (on Route 30 at Central Garage) where trash is placed into steel containers. Three old landfill sites in King William County have been properly closed (King William County Comprehensive Plan, 2003).

Water and Wastewater: The vast majority of King William County residents are served by private wells and septic systems. King William County does have three small water systems with specific service areas. **Service Area 1** serves the Central Garage area. This area has a 30,000-gallon water tower and serves the businesses in Central Garage at the U.S. 360 / Route 30 intersection. The water supply is well water, which is chlorinated by County personnel. King William County also installed a 25,000-gallon per day wastewater treatment to serve the Central Garage service area. **Service Area 2** is at the King William County Industrial Park and is supplied by well water. There is a 10,000-gallon water storage tank, but no water treatment occurs. The system serves one industrial customer owned by Nestle producing cat litter. **Service Area 3** is at the King William Courthouse and is supplied by well water. A 2,000-gallon storage tank serves the eight County-owned buildings. The courthouse area is served by an enhanced drainfield system for wastewater. The County also has a well that serves the King William Recreational Park on Route 30 (King William County Comprehensive Plan, 2003).

Transportation and Evacuation Routes: The existing public road system consists of primary and secondary State roads. In 1995, there were 312.89 miles of state roads in King William County. Nearly all of the County's primary and secondary roads are hard surfaced. Primary roads are numbered less than "600". Secondary roads carry a name 600 or higher. The primary evacuation route heading west is Virginia Primary Highway Route 30 (Route 30, also known as King William Highway). This route runs northwest-southwest between West Point at the lower end of the County and through Mangohick at the upper end of the County. Route 30 provides access to Interstate 95. U.S. Highway Route 360 runs through the northwest sector of the County and through the villages of Aylett, Central Garage, and Manquin, and provides access to Interstate 295 and Route 17. Route 33 crosses through the Town of West Point at the southern end of the County and provides access to Interstate 64 and Route 17 (King William County Comprehensive Plan, 2003).

6.3.1.5. *Town of West Point*

Fire and Rescue: The West Point Volunteer Fire Department and Rescue Squad serve the Town and portions of adjacent localities.

Law Enforcement: The Town Police Department is responsible for the majority of law enforcement efforts in the Town. The Department's headquarters are located on 12th Street in the rear of the West Point Station shopping center. The Town operates an Emergency Communications Department (E-911 Dispatch) and will have wireless 911 capability by July 2005.

Town Administration: Town Administrative offices are located 329 6th Street. The Public Works Department and Shop are located at the west end of 7th Street. The Parks and Recreation Department is located on 6th Street and the Police Department is located on 12th Street in leased space at the rear of the West Point Station Shopping Center.

Hospital and Health Services: Tidewater Physicians Medical Center is located on Main Street in Town. As part of the Virginia Department of Health's Three Rivers Health District, the King William County Health Department offers an array of health services to local citizens. The Health Department offices are located near the County's Administrative Office Complex. There are no hospitals within the Town or adjacent Counties. Regional health care facilities that serve the Town include: Riverside Hospitals in Gloucester and Tappahannock; Bon Secours Regional Medical Center in Hanover County; Williamsburg Community Hospital in Williamsburg and other medical facilities in the Richmond area.

Emergency Operations: Emergency Operations for the Town are directed and controlled from Town Hall Emergency Operations Center. While the Town prepares and maintains a separate Emergency Operations Plan, the Town is not a separate Emergency Planning Area within Virginia and thus works with King William County during regional emergency events. Chain of command and emergency operations procedures to be followed during an emergency incident are described in detail in the Town's Emergency Operations Plan. The Emergency Operations Plan also describes Hazard Mitigation responsibilities within the Town.

Schools: The Town of West Point operates an independent school division. The High School, Middle School and Elementary School and associated recreation facilities are located at the intersection of Thompson Avenue and Mattaponi Avenue. The High School Gymnasium is a Red Cross Certified Hurricane Evacuation Shelter and may also be used during other emergency events.

Solid Waste: The Town of West Point participates through King William County in a regional solid waste management system that is operated by the Virginia Peninsulas Public Service Authority (VPPSA), headquartered in Williamsburg.

The Town provides weekly residential trash collection service, weekly recyclable material collection and picks up brush and similar debris based on calls for service from residents. Citizens can also take trash to three convenience centers (Epworth Road Convenience Center, Landfill Convenience Center on King William Highway (Route 30), VFW Road Convenience Center) and one transfer station (on Route 30 at Central Garage) where trash is placed into steel containers.

Water and Wastewater: Water and Sewer service is not available to all properties on the Town. The majority of developed properties in Town are served by a Town owned and operated water system with sewage collection and treatment handled by the Small Communities Division of the Hampton Roads Sanitation District (HRSD). The Town has three interconnected wells for the water system - #1 Town Hall (6th Street), #2 – Schools and #3 Chelsea Road. Elevated water storage tanks with 0.5 million gallon capacity are located at Well #1 and Well #2. Permanent electrical back-up generator power is available to Well #1 and Town Hall. Transfer switches are installed at Well #2 and Well #3 for connection to a trailer-mounted generator. Some Town properties are served by individual wells and on-site sewage disposal systems. There are no privately owned and operated water systems serving development other than the industrial wells serving Smurfit-Stone Container Corporation. HRSD operates a wastewater treatment plant in Town that is not interconnected with any other locality's sewage collection system.

Transportation and Evacuation Routes: The existing public road system consists of primary and secondary roads maintained by the State of Virginia. All roads maintained by the Virginia Department of Transportation are paved. The Town has many unimproved public right of ways with varying degrees of adjacent development. The Town also has many unimproved private roads with varying degrees of adjacent development.

The primary evacuation route heading west is Virginia Primary Highway Route 30 (also known as King William Avenue in Town and King William Highway in King William County). This route runs northwest-southwest between West Point at the lower end of the County and through Mangohick at the upper end of the County. Route 30 provides access to U.S. Highway 360 and Interstate 95. U.S. Highway Route 360 runs through the northwest sector of the County and through the villages of Aylett, Central Garage and Manquin and provides access to Interstate 295 and Route 17. Route 33 (known as 14th Street in Town) crosses through the Town of West Point at the southern end of King William County and provides access to Interstate 64 and Route 17.

6.3.1.6. *Mathews County*

Fire and Rescue: Public safety in Mathews County is typical of many rural counties in Virginia. There is a County Sheriff's office that handles most of the

police work in the County and volunteer fire station and rescue squads that handle their respective duties. Mathews County also has working agreements with neighboring counties to provide mutual assistance if needed. Communications are coordinated through the 911 dispatchers at the sheriff's office in the village of Mathews. There are five separate volunteer fire departments in Mathews as well as one volunteer rescue squad. The fire stations are located in Mathews Village Center, Cobbs Creek, Bohannon, Gwynn's Island, and New Point. Department equipment includes seven pump engines, one brush truck, and one heavy rescue vehicle. The rescue squad is located on Route 14/198 just north of the Courthouse. The squad has two advanced life support ambulances, two basic life support ambulances, one rescue boat, and one general rescue vehicle. Though these various departments get some of their funding from the County, most of their funding comes from private sources and from fundraising ventures that the departments engage in through out the year.

Law Enforcement: Law Enforcement is provided through the Sheriff's department which is staffed by 12 full-time, one part-time, and two auxiliary deputies, dispatchers and support personnel. The sheriff's office is located on the Courthouse Green in the village of Mathews. There is a small holding facility for arrests, court appearance holdings, or for prisoners awaiting transportation to the regional jail in Saluda. Three Virginia State Highway Patrolmen are also assigned to the County.

County Administration: The County administrative offices are located in the historic courthouse greens. The County's Board of Supervisors includes five members elected at large who serve four year staggered terms. The Board appoints a County Administrator who serves as the chief administrative officer of the County government.

Hospital and Health Services: County of Mathews residents are served by Riverside Walter Reed Hospital located in Gloucester County about 15 miles west of Mathews. The County has local clinic's that serve a full range of family oriented health care services. Additional medical services are available at Newport News hospitals, Williamsburg Community Hospital, and Sentara Hampton General Hospital. These facilities offer a full range of acute care services that include emergency care, obstetrics, surgery and full diagnostic services. Close proximity to Richmond also permits residents to utilize the Medical College of Virginia, and internationally known teaching medical center.

Emergency Operations: Emergency Operations for Mathews County are directed and controlled from the County Emergency Operations Center. Chain of command and emergency operations procedures to be followed during and emergency incident are described in detail in the County's Emergency Operations Plan. The Emergency Operations Plan also describes Hazard Mitigation responsibilities within the County. The Emergency Management

Coordinator is charged with the overall responsibility of coordinating the development and implementation of hazard mitigation plans.

Schools: Schools are provided in Mathews County by the Mathews County School Board through the office of Superintendent of Schools. The Board, together with its administrative staff, is responsible for providing a high quality system of public school facilities and educational program. There are three schools in the County: Mathews High School, Thomas Hunter Middle School, and Lee-Jackson Elementary School.

Solid Waste: Mathews County operates a convenience center/transfer station of Route 14 (John Clayton Memorial Hwy) that accepts recyclables and residential and commercial waste. The County is a member of the Virginia Peninsula's Public Service Authority (VPPSA). VPPSA provides solid waste management services to its member communities. These services include recycling, waste transfer, disposal, and environmental monitoring. Member communities participate in recycling programs for oil, antifreeze, tires, appliances, and automotive batteries. Before becoming a member of VPPSA, Mathews County operated its own landfill on Route 626 near the Cobbs Creek area. That landfill has since been closed and capped. Monitoring of the landfill is undertaken by VPPSA. The County does not offer public collection of solid waste on an individual basis, but collection is offered by several private contractors.

Water and Wastewater: Water comes from three aquifers with most of the major wells taking water from the second level aquifer. Most of the domestic wells, however, take water from the water table aquifer, the one closest to the surface. While this water can tend to be brackish in the eastern part of the County, there are still adequate supplies for the foreseeable future. The vast majority of Mathews County residents are served by private wells and septic systems. Hampton Road Sanitation has one small sewage disposal system that services residents in the sanitary district.

Transportation and Evacuation Routes: Mathews County is served by a network of primary and secondary roads that are maintained by the Virginia Department of Transportation (VDOT). Three Virginia Primary Highway's (Routes 198,14, and 3) provide evacuation routes for Mathews County. Each of the primary routes provides access to Route 17.

6.3.1.7. *Middlesex County:*

Fire and Rescue: Middlesex County is served by four (4) volunteer fire organizations spread throughout the County, at Water View, Urbanna, Hartfield and Deltaville. There are approximately 125 volunteer members on these departments. Two (2) rescue squads operate in the County, one from the Town of Urbanna and one from Deltaville, with approximately 90 members. Some paid

rescue workers man the Central Middlesex Department in Urbanna during daytime hours. All units are dispatched County-wide from the Dispatch Office. Mutual aid policies are in effect with surrounding counties.

Law Enforcement: The Middlesex County Sheriff's Department is located in Saluda and staffed by the Sheriff and eleven (11) full-time deputies. An additional seven (7) deputies are employed part-time along with 10 volunteer security patrol officers.

County Administration: Most administrative offices for the County are located at the Courthouse Complex in Saluda and include: administration and offices of planning and community development – building, planning and zoning, wetlands, erosion and sediment control, and recreation. Offices for the Treasurer, Commissioner of the Revenue and Registrar are also in this building. The Department of Social Services is located approximately two (2) miles east at the Cooks Corner Office Complex.

Hospital and Health Services: There are no hospitals located in Middlesex County, but there are three (3) small hospitals located within 30 miles of Saluda. There are several physicians that operate private practices in the County.

Emergency Operations: Emergency Operations for Middlesex County are directed and controlled from the Emergency Operations Center. Chain of command and emergency operations procedures to be followed during an emergency incident are described in detail in the County's Emergency Operations Plan.

Schools: The Middlesex County School Board operates a consolidated public school system at three sites in the County: Middlesex Elementary and St. Clare Walker Middle School at Locust Hill and Middlesex High School in Saluda. Christ Church School, a private boarding school for boys and day school for girls and boys, grades 8 to 12, operates at Christ Church, Virginia.

Solid Waste: The County operates three (3) collection centers in the County for disposal of household waste. The Virginia Peninsulas Public Service Authority, headquartered in Williamsburg, operates a collection site/Transfer Station at Stormont. All waste collected at the County collection centers and Transfer Station is transported to a commercial landfill outside the County. The Middlesex County Landfill closed in 1993.

Water and Wastewater: Aqua Virginia owns and operates the water system used in the Village of Saluda. Many private subdivisions also have central water supplies owned and operated privately. The Hampton Roads Sanitation District operates the wastewater treatment system for the Town of Urbanna. A wastewater treatment facility to serve the Middlesex County Courthouse Complex and several businesses east of the Village of Saluda is in the design

stage. The rest of the County residences are served by private wells and on-site disposal.

Transportation and Evacuation Routes: The existing public road system consists of primary and secondary State roads. All inter-county traffic and much intra-county travel is dependent upon Routes 17 and 33 which connect Essex County to surrounding metropolitan areas. Route 17 has shown substantial increases in traffic volumes in recent years with the greatest increase attributable to truck traffic. Waterways and the airport facility have played a minor role as alternate transportation modes. Middlesex County operates the airport located adjacent to a small industrial area located in Topping. The facility is used primarily by private individuals, transients for fuel stops, and local businesses and industries.

6.3.1.8. *Town of Urbanna:*

Fire and Rescue: The Town of Urbanna is served by two volunteer organizations, the Middlesex Volunteer Fire Department, Urbanna Station and the Central Middlesex Volunteer Rescue Squad, Urbanna Station. The fire department has approximately 40 members and is equipped with a brush truck, one engine, two tanker pumpers, rescue truck, and two command vehicles. The rescue squad operates three ambulances, which are ALS equipped and has over 35 members. The combined calls of the two departments average 90 per month during recent years. Units are dispatched town wide from the Middlesex County Sheriff's Department 911 Center.

Law Enforcement: The Town is served with police protection under a Police Services Agreement with the Sheriff's Department of the County of Middlesex.

Town Administration: The Town Offices are located at 45 Cross Street, Urbanna, Virginia. The Town employs a full time administrator, clerk, treasurer, water operator, parks and recreation director, and grants administrator.

Hospital and Health Services: There are three (3) hospitals located within a 30 mile radius of the Town of Urbanna-Rappahannock General, Kilmarnock, Virginia; Riverside Walter Reed, Gloucester, Virginia; and Riverside Tappahannock, Tappahannock, Virginia.

Emergency Operations: Emergency Operations for the Town of Urbanna are directed and controlled by the Town Administrator in conjunction with the Middlesex County Emergency Operations Center.

Schools: The Middlesex County School Board operates a consolidated public school system in which the children of Urbanna attend.

Solid Waste: The Town of Urbanna contracts for curb side waste removal and curb side recycling for all residents.

Water and Wastewater: Public water and sewer facilities are available for all Town residents. In addition, the water and sewer system extends outside the Town limits to provide service to surrounding areas. The public water system is owned and operated by the Town of Urbanna and the public sewer system is operated by Hampton Roads Sanitation District.

Transportation and Evacuation Routes: The existing public road system consists of primary and secondary roads. Town traffic is dependent on Rt. 17, Rt. 33, Rt. 602, and Rt. 227

6.3.2. Hazard-specific Capabilities

6.3.2.1. Hurricanes and Coastal Storms:

6.3.2.2. Flooding:

In response to increasing losses from flood hazards nationwide, the Congress of the United States passed the National Flood Insurance Act of 1968 which established the National Flood Insurance Program (NFIP). The 1968 Act provided for the availability of flood insurance within communities that were willing to adopt floodplain management programs to mitigate future flood losses. The act also required the identification of all floodplain areas within the United States and the establishment of flood-risk zones within those areas. As a result of the 1972 Hurricane Agnes flooding along the East coast, the 1968 Act was expanded by the Flood Disaster Protection Act of 1973. The 1973 Act added the mandatory flood insurance purchase requirement and increased the awareness of floodplain mapping needs throughout the country. The responsibility for administration of the NFIP falls with the Federal Insurance Administration of the Federal Emergency Management Agency (FEMA).

The risk data to identify floodplain areas, as required by the Act, are acquired through Flood Insurance Studies (FISs). FISs are hydrologic and hydraulic studies of flood risks developed by FEMA. Using the results of a FIS, FEMA prepares a Flood Insurance Rate Map (FIRM) that depicts the spatial extent of Special Flood Hazard Areas (SFHAs) and other thematic features related to flood risk assessment. SFHAs are areas subject to inundation by a flood having a one-percent or greater probability of being equaled or exceeded during any given year. This flood, which is referred to as the 1% annual chance flood (or base flood), is the national standard on which the floodplain management and insurance requirements of the NFIP are based.

FEMA publishes the FIRM and distributes it to a wide range of users: private citizens, community officials, insurance agents and brokers, lending institutions, and other Federal agencies. The FIRM is the basis for floodplain management, mitigation, and insurance activities of the NFIP. Uses of the FIRM for insurance activities include enforcement of the mandatory purchase requirement of the 1973 Act, which ". . . requires the purchase of flood insurance by property owners who are being assisted by Federal programs or by Federally supervised, regulated, or insured agencies or institutions in the acquisition or improvement of land or facilities located or to be located in identified areas having special flood hazards" (Section 2(b)(4) of the 1973 Act). In addition to the identification of SFHAs, the risk zones shown on the FIRMs are the basis for the establishment of premium rates for flood coverage offered through the NFIP.

Figure 17 shows the current status of FEMA floodplain maps in Virginia. A majority of communities only have paper Flood Insurance Rate Maps (FIRMs), although FEMA Region III and the Virginia Department of Conservation and Recreation (DCR) is taking part on Map Modernization efforts, which aim to have the entire national with Digital FIRMs (DFIRMs) by 2009. A Digital Flood Insurance Rate Map (DFIRM) includes all digital data required to create the hardcopy Flood Insurance Rate Map to FEMA FIA-21 standards and specifications. It includes base map information, graphics, text, shading, and other geographic and graphic data. DFIRM specifications are consistent with those required for mapping at a scale of 1:24,000, or larger. DFIRMs generally are produced in a countywide format. They include information from the unincorporated areas of a county and all the incorporated communities within that county.

Gloucester, Mathews, and Middlesex Counties have Q3 Flood Maps. The Q3 Flood Data product is a digital representation of certain features of FEMA's Flood Insurance Rate Maps, intended for use with desktop mapping and Geographic Information Systems technology. Scanning the existing FIRM paper hardcopy and vectorizing a thematic overlay of flood risks created digital Q3 Flood Data. Because digital Q3 Flood Data are controlled to the USGS 1:24,000 scale maps, they may not be detailed enough for some uses. The hardcopy Flood Insurance Rate Map or Digital Flood Insurance Rate Map should be used to make official determinations, especially if a property is close to the boundary of the mapped Special Flood Hazard Area. The vector Q3 Flood Data files contain only certain features from the existing FIRM hardcopy.

Essex, King and Queen, and King William Counties only have paper Flood Insurance Rate Maps (FIRMs).

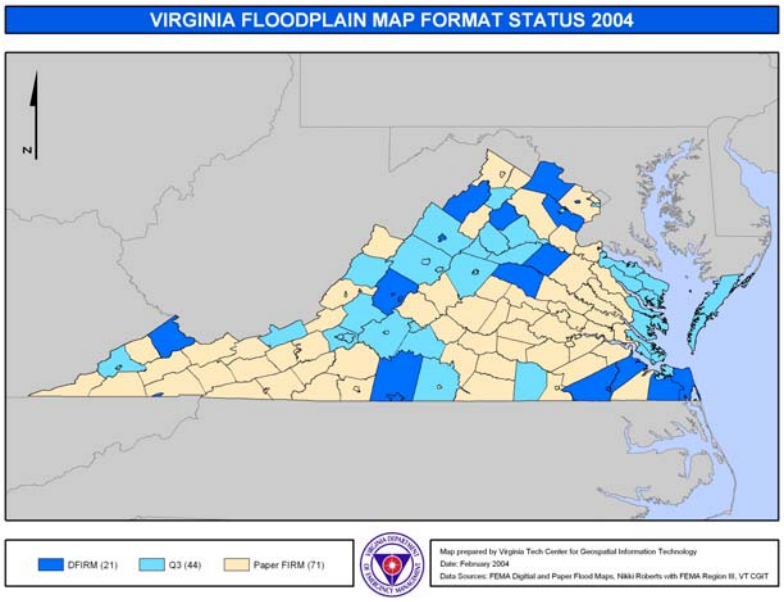

Figure 17: Virginia Floodplain Map Status (figure courtesy of VDEM). Gloucester, Mathews, and Middlesex Counties have Q3 Flood Maps, while Essex, King and Queen, and King William Counties only have paper Flood Insurance Rate Maps (FIRMs).

For each of the following sections, elaborate on the floodplain ordinance of each county:

6.3.2.2.1. *Essex County*

The Flood Plain Management Ordinance of Essex County, Virginia (adopted 10/11/1988) shall apply to all property located within an area identified as being subject to inundation by water of the one hundred (100) year flood event, and as such shall supplement the regulations of the zoning district within which such property is located. These regulations are intended to ensure the health, safety, and general welfare of the public by ensuring that inhabitants and property within a designated flood plain area are safe from damage to flooding and will not endanger others. The ordiance complies with the requirements of the National Flood Insurance Program (42 U.S.C. 4001-4128) of the Federal Insurance Administration. These regulations are necessary in order for all property owners within the County to be eligible for the National Flood Insurance Program and thereby purchase such insurance at nominal rates. Where these regulations are at variance with the general regulations of the County, it is intended that these regulations shall apply. The Flood Plain Management Ordinance of Essex County, Virginia has recently been reviewed and approved by FEMA.

6.3.2.2.2. *Town of Tappahannock*

The Flood Plain Management Ordinance of Essex County, Virginia (adopted 10/11/1988) shall apply to the Town of Tappahannock. All property

located within an area identified as being subject to inundation by water of the one hundred (100) year flood event, and as such shall supplement the regulations of the zoning district within which such property is located. These regulations are intended to ensure the health, safety, and general welfare of the public by ensuring that inhabitants and property within a designated flood plain area are safe from damage to flooding and will not endanger others. The ordinance complies with the requirements of the National Flood Insurance Program (42 U.S.C. 4001-4128) of the Federal Insurance Administration. These regulations are necessary in order for all property owners within the County to be eligible for the National Flood Insurance Program and thereby purchase such insurance at nominal rates. Where these regulations are at variance with the general regulations of the County, it is intended that these regulations shall apply. The Flood Plain Management Ordinance of Essex County, Virginia and by extension the Town of Tappahannock has recently been reviewed and approved by FEMA.

6.3.2.2.3. *Gloucester County*

Gloucester County has a Floodplain Management Ordinance (Chapter 8.5 of the Gloucester County Code) that is intended "to prevent the loss of property and life, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:
(1). Regulating uses, activities and development which, acting alone or in combination with other existing or future uses, activities and development, will cause unacceptable increases in flood heights, velocities and frequencies;
(2). Restricting or prohibiting certain uses, activities and development from locating within areas subject to flooding;
(3). Requiring all those uses, activities, and developments that do occur in flood-prone areas to be protected and/or flood-proofed against flooding and flood damage;
(4). Protecting individuals from buying lands and structures, which are unsuited for intended purposes because of flood hazards (§8.5-5).
This ordinance was adopted July 7, 1987.

The various floodplain districts shall include areas subject to inundation by waters of the one hundred-year flood. The basis for the delineation of these districts shall be the Flood Insurance Study (FIS) and accompanying Flood Insurance Rate Maps (FIRM) for Gloucester County prepared by the Federal Emergency Management Agency, Federal Insurance Administration, dated August 4, 1987, as amended. Four flood zone categories make up the floodplain districts of Gloucester County.

The floodway district (AE zones) - must be capable of carrying the waters of the one hundred-year flood without increasing the water surface elevation of that flood more than one (1) foot at any point.
The flood-fringe district (AE zones) - shall be that area of the one hundred-year floodplain not included in the floodway district.

The approximated floodplain district (A zones) - shall be that floodplain area for which no detailed flood profiles or elevations are provided, but where a one hundred-year floodplain boundary has been approximated.

Coastal high-hazard area district (V and VE zones) - shall be those portions of land within the coastal floodplain subject to inundation by high velocity waters and wave action.

The boundaries of the floodplain districts are established as shown on the FIRM, which shall be kept on file at the county office of community development and codes compliance. The Director of Community Development and Codes Compliance is responsible for making initial interpretation of the boundaries of the floodplain district. Floodplain districts may be revised by the Board of Supervisors however, approval must be obtained from the Federal Insurance Administration. (§8.5-21, 8.5-22, 8.5-23, 8.5-24)

A structure or use of a structure or premises which lawfully existed before the enactment of these provisions, but which is not in conformity with these provisions may be continued subject to the following conditions:

The modification, alteration, repair, reconstruction or improvement of any kind to a structure and/or use regardless of its location in a floodplain to an extent or amount of fifty (50) percent or more of its market value shall be undertaken only in full compliance with the provisions of the Virginia district Uniform Statewide Building Code and this chapter. (§8.5-9)

Gloucester County established classification as an eligible community in the Community Rating System (CRS), which is a voluntary program for NFIP-participating communities. The County has established a Design Flood Elevation (DFE) that goes beyond the minimum requirements by requiring an additional one foot of elevation to the Base Flood Elevation (BFE). New construction or substantial improvement type construction, including mechanical or electrical systems, shall be elevated at or above the DFE.

The County of Gloucester has received grant funding as an eligible community under the FEMA Hazard Mitigation Grant Program (HMGP).

This program incorporates both an acquisition/demolition and elevation component to reduce reoccurring damage to properties in flood prone areas. As funding allows Gloucester plans to continue to mitigate the exposure from flood damage through this program.

Additionally, the vast majority of the flood prone lands in the County are currently zoned for low density development. The Bayside Conservation District (C-2), which encompasses much the low elevation area in the County, provides for only one dwelling unit per 5 acres. Other zoning districts in flood prone areas such as Rural Conservation (RC-2) and Conservation (C-2) further restrict residential density or do not permit development at all. Restrictions in regards to the Chesapeake Bay Preservation Act and accompanying State statutes enhance the environmental characteristics of low lying flood prone areas by restricting overall development within 100 feet of the shoreline and providing performance standards for environmental protection outside the buffer areas.

NFIP Participation: Gloucester County has participated in the NFIP since it adopted the Floodplain Ordinance in 1987. Between 1987 and December 31, 2004, Gloucester County has had 894 insurance claims and $24,578,586.16 has been paid for flood damage. The average claim over the entire county is $27,492.83.

6.3.2.2.4. *King and Queen County*

The County has a standard floodplain ordinance and program as prescribed by state and federal floodplain management agencies. Although the County is currently seeing a trend with the development of waterfront lots, mainly along the Mattaponi River, the lots are large enough to allow for the construction of houses, outbuildings and septic system drain field areas outside of the floodplain, but within view of the river and/or other water bodies. The County continues to be in compliance during our audits of building permit activity conducted by state and federal floodplain review teams

6.3.2.2.5. *King William County*

King William County has a Floodplain Management Ordinance (ARTICLE II. Flood Damage Prevention) of the King William County Code). The purpose of the provisions of this article is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base by:

(1) Regulating uses, activities, and development which, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies.

(2) Restricting or prohibiting certain uses, activities, and development from locating within areas subject to flooding.

(3) Requiring all those uses, activities, and developments that do occur in floodprone areas to be protected and/or floodproofed against flooding and flood damage.

(4) Protecting individuals from buying land and structures which are unsuited for intended purposes because of flood hazards.
(Code 1987, 6.5-1)

The provisions of this article shall apply to all lands within the jurisdiction of the county and identified as being in the 100-year floodplain by the Federal Insurance Administration.
(Code 1987, 6.5-2)

(a) No land shall hereafter be developed and no structure shall be located, relocated, constructed, reconstructed, enlarged, or structurally altered except in full compliance with the terms and provisions of this article and any other applicable ordinances and regulations which apply to uses within the jurisdiction of this article.

(b) The degree of flood protection sought by the provisions of this article is considered reasonable for regulatory purposes and is based on acceptable engineering methods of study. Larger floods may occur on rare occasions. Flood heights may be increased by manmade or natural causes, such as ice jams and bridge openings restricted by debris. This article does not imply that areas outside the floodplain area, or that land uses permitted within such area, will be free from flooding or flood damages.

(c) This article shall not create liability on the part of the county or any officer or employee thereof for any flood damages that result from reliance on this article or any administrative decision lawfully made under this article.
(Code 1987,. 6.5-3)

6.3.2.2.6. *Town of West Point*
The Town of West Point does not have a Floodplain Ordinance. Floodplain issues associated with new construction and additions to existing construction are addressed by the Building Official as part of the administration of the VA

Uniform Statewide Building Code. Section 70-419 of the Town's Zoning Ordinance does require that buildings destroyed more than 60% be reconstructed only in accordance with current zoning ordinance requirements.

6.3.2.2.7. *Mathews County*

Mathews County has a Floodplain Management Ordinance (Chapter 63 of the Mathews County Code) that is intended "to prevent the loss of property and life, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base" (§63-3). This ordinance regulates activities, establishes building performance requirements for development and redevelopment in floodplains, and protects individuals from buying lands and structures that are unsuited for intended purposes because of flood hazards. This ordinance was adopted April 28, 1987.

The floodplain districts of Mathews County include areas subject to inundation by waters of the one-hundred-year flood based on the delineation by the Flood Insurance Study and accompanying Flood Insurance Rate Maps (FIRM) dated February 4, 1987. Two flood zone categories make up the floodplain districts of Mathews County: The Coastal Floodplain District and the Coastal High Hazard Area. The Coastal Floodplain District (A Zones) is made up of those portions of the floodplain district subject to coastal flooding by a one-hundred-year flood, where detailed study data is available. The Coastal High Hazard Area (V Zones) is made up of those portions of land within the coastal floodplain subject to inundation by high-velocity waters and wave action. The boundaries of these floodplain districts are established as shown on the Flood Insurance Rate Maps, which are kept on file at the County of Mathews, Virginia, code enforcement offices. The Mathews County Building Official is responsible for making initial interpretation of the boundaries of the floodplain districts (§63-10).

For all construction activities occurring after this ordinance was adopted in 1987, all building permit applications must be reviewed by the Building Official to determine whether proposed building sites will be reasonably safe from flooding. According to §63-11 of the Mathews County Code, if a proposed building site is in a flood-prone area, all new construction and substantial improvements shall:

(1) Be designed (or modified) and adequately anchored to prevent flotation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
(2) Be constructed with materials resistant to flood damage;
(3) Be constructed by methods and practices that minimize flood damages; and
(4) Be constructed with electrical, heating, ventilation, plumbing, and air-conditioning equipment and other service facilities that are designed

and/or located to prevent water from entering or accumulating within the components during conditions of flooding.

There are exceptions for structures pre-dating the adoption of this floodplain ordinance. According to §63-18, "a structure or use of a structure or premises which lawfully existed before the enactment of these provisions but which is not in conformity with these provisions may be continued subject to the following conditions: the modification, alteration, repair, reconstruction or improvement of any kind to a structure and/or use, regardless of its location in a floodplain district, to an extent or amount of 50% or more of its market value shall be undertaken only in full compliance with the provisions of the Virginia Uniform Statewide Building Code and the Mathews County Floodplain Ordinance". In other words, if a pre-existing structure is located in a floodplain district, any repairs, alterations, or improvements on the structure that increase the fair market value by 50% or more must meet the current building codes that take into account the floodplain ordinance.

NFIP Participation: Mathews County has participated in the NFIP since it adopted the Floodplain Ordinance in 1987. Between 1987 and June 2004, Mathews County has had 769 insurance claims and $12,921,522 has been paid for flood damage. The average claim over the entire county is $16,803. As of December 31, 2003, there were no repetitive loss properties within the county.

6.3.2.2.8. *Middlesex County:*

Middlesex County has a Floodplain Management Ordinance that is intended "to prevent the loss of property and life, the creation of health and safety hazards, the disruption of commerce and governmental services, the extraordinary and unnecessary expenditure of public funds for flood protection and relief, and the impairment of the tax base". This ordinance regulates activities, establishes building performance requirements for development and redevelopment in floodplains, and protects individuals from buying lands and structures that are unsuited for intended purposes because of flood hazards. This ordinance was adopted December 6, 1988, with an effective date of January 1, 1989, and was amended December 4, 1990.

The floodplain districts of Middlesex County include areas subject to inundation by waters of the one-hundred-year flood based on the delineation by the Flood Insurance Study and accompanying Flood Insurance Rate Maps (FIRM) dated 1989. Two flood zone categories make up the floodplain districts of Middlesex County: The Coastal Floodplain District and the Coastal High Hazard Area. The Coastal Floodplain District (A Zones) is made up of those portions of the floodplain district subject to coastal flooding by a one-hundred-year flood, where detailed study data is available. The Coastal High Hazard Area (V Zones) is

made up of those portions of land within the coastal floodplain subject to inundation by high-velocity waters and wave action. The boundaries of these floodplain districts are established as shown on the Flood Insurance Rate Maps, which are kept on file at the County of Middlesex, Virginia, Community Development and Planning Offices. The Middlesex County Department of Community Development is responsible for making initial interpretation of the boundaries of the floodplain districts.

For all construction activities occurring after this ordinance was amended and readopted in 1990, all building permit applications must be reviewed by the Building Official to determine whether proposed building sites will be reasonably safe from flooding.

There are exceptions for structures pre-dating the adoption of this floodplain ordinance. According to Article VI, "a structure or use of a structure or premises which lawfully existed before the enactment of these provisions but which is not in conformity with these provisions may be continued subject to the following conditions: the modification, alteration, repair, reconstruction or improvement of any kind to a structure and/or use, regardless of its location in a floodplain district, to an extent or amount of 50% or more of its market value shall be undertaken only in full compliance with the provisions of the Virginia Uniform Statewide Building Code and the Middlesex County Floodplain Ordinance". In other words, if a pre-existing structure is located in a floodplain district, any repairs, alterations, or improvements on the structure that increase the fair market value by 50% or more must meet the current building codes that take into account the floodplain ordinance.

NFIP Participation: Middlesex County has participated in the NFIP since it adopted the Floodplain Ordinance, which became effective in 1989. Between 1987 and December 2004, Middlesex County has had 140 insurance claims and $1,553,343.13 has been paid for flood damage. The average claim over the entire county is $11,095.31. As of December 31, 2003, there were no repetitive loss properties within the county

6.3.2.2.9. *Town of Urbanna:*

Flood Plain Ordinance: The Town of Urbanna has a flood plain ordinance Section 17-4.11. The purpose of this Article is to prevent the loss of life and property, the creation of health and safety hazards, the disruption of commerce and governmental services, and the extraordinary and unnecessary expenditures of public funds for flood protection and relief, and the impairment of the tax base by:

(1) Regulating uses, activities, and development which, alone or in combination with other existing or future uses, activities, and development, will cause unacceptable increases in flood heights, velocities, and frequencies;

(2) Restricting or prohibiting future uses, activities, and development from locating within areas subject to flooding;

(3) Requiring all those uses, activities, and developments that do not occur in flood-prone areas to be protected and/or flood proofed against flooding and flood damage; and

(4) Protecting individuals from buying lands and structures which are unsuited for intended purposes because of flood hazards.

The flood plain district includes areas subject to inundation by waters of the one hundred (100)-year flood. The basis for the delineation of the district shall be the one hundred (100)-year flood elevations or profiles contained in the Flood Insurance Study for the Town of Urbanna prepared by the Federal Emergency Management Agency, Federal Insurance Administration, dated November 5, 1989, as amended. The FIRM Map Community Panel #5102920001A, dated November 3, 1989. The Town has two zones, AE and X.

6.3.3. Tornadoes

The Commonwealth of Virginia is responsible for enacting the Virginia Uniform Statewide Building Code (USBC) (available electronically at: http://www.dhcd.virginia.gov/Forms/DBFR/1USBC.pdf), which localities are responsible for enforcing locally. Housing and Building codes for all of the localities within the Middle Peninsula are designed to protect health, safety, and general welfare of the region's residents by providing minimum standards for all types of structures. Each locality's Buildings Inspections Department is principally responsible for enforcing Commonwealth and County or Town codes for building residential and commercial structures, enforcing environmental codes, and guiding the maintenance of existing structures. The USBC dictates that buildings constructed within each locality within the Middle Peninsula be built to withstand 100 mile-per-hour winds.

7. Mitigation Strategy

The Middle Peninsula Risk Assessment and Mitigation Planning (RAMP) committee reviewed and discussed formulating mitigation goals in preparation for identifying the goals for the Plan. During the development of the Hazard Identification and Risk Assessment (HIRA) section (see Section 4) and Vulnerability Assessment (see Section 5) of this Plan, the RAMP Committee learned that:

- Flooding resulting from hurricanes, tropical storms, and other coastal storms, such as nor'easters, pose a significant threat to the community throughout the year.

- Wind damage from these storms, as well as tornadoes, also pose a threat.

- Most meteorological hazards (snow and ice storms, severe thunderstorms, etc.) occur seasonally and periodically. While not a significant, year-round threat, the Middle Peninsula is vulnerable to these hazards.

The Capability Assessment describes the Middle Peninsula's current ability to counter the threats to these hazards through existing policies, regulations, programs, and procedures. For example, during this plan development process, the RAMP committee learned that:

- The Counties' and Town's Comprehensive Plans do not thoroughly address all hazard issues to which the area is most vulnerable. There is a lack of sufficient and compatible data between county departments to comprehensively and effectively inventory resources and potential hazard vulnerabilities.

- A household chemical collection program can help minimize the scattering of containers and chemicals during flood and wind (tornado) events. In Gloucester, Harmful Household Chemical Collections are conducted twice annually - spring and fall. Dates and times are advertised in local newspapers and the community newspaper, *The Beehive*.

- The public warning systems within each County and Town are in need of improvement. Gloucester County is the only Middle Peninsula locality with a Reverse-911-type public communication warning system. Because natural hazards often do not stop at jurisdictional borders, it would be beneficial to the Middle Peninsula localities to have a regionally-compatible system in place. The region needs to develop procedures concerning this type of technology for decision making, dissemination of warnings, public education regarding emergency procedures and warning messages, and conducting training exercises for emergency personnel.

- The Counties and Towns of the Middle Peninsula are vigilant about protecting natural resources and refer to the Chesapeake Bay Act and wetland regulations for guidance. Because flood-prone areas often overlap with the Chesapeake Bay Resource Protection Areas (RPAs), the restriction of development within the RPAs is an aid to the region's floodplain management.

The RAMP committee identified areas where improvements could be made, providing the framework for the RAMP committee to formulate planning goals so that improvements could be incorporated into this Mitigation Plan. Goals and objectives were established and each RAMP committee member participated in a mitigation strategy brain-storming exercise during one of the RAMP committee meetings. A variety of potential mitigation projects were proposed for inclusion in the 'Mitigation Strategy' section of the Regional Natural Hazards Mitigation Plan document. These goals and objectives provided the direction for reducing future hazard-related losses within the Middle Peninsula.

GOAL 1: Prevent Future Hazard Related Losses

Objective 1.1: Provide protection for future development to the extent possible

Objective 1.2: Provide protection for Critical Public Facilities and Services

GOAL 2: Improve Community Emergency Management Capability

Objective 2.1: Improve ability to communicate to residents and businesses during and following emergencies and disasters

Objective 2.2: Improve ability of locality to communicate with state Emergency Operations Center during state-and federally-declared disasters

GOAL 3: Increase Public Awareness of Vulnerability to Hazards

Objective 3.1: Provide information to residents and businesses about the types of hazards they are exposed to, where they occur, and what they can do to be better prepared

Objective 3.2: Improve Mapping Capabilities

Objective 3.3: Improve Hurricane Storm Surge Mapping Capabilities

Once the goals and objectives were identified, the RAMP committee generated a list of viable alternatives that would help to meet these goals. Each RAMP committee member was provided with the following list of categories of mitigation measures:

- Prevention
- Emergency Services
- Property Protection
- Natural Resource Protection
- Structural Projects
- Public Education / Outreach

The following section is the Action Plan which lists prioritized recommendations, arranges by Goal, Objective, Proposed Mitigation Action, and Locality, for Middle Peninsula communities to pursue in order to lessen the vulnerability of people, property, infrastructure, and natural and cultural resources from future disaster losses.

7.1. MITIGATION STRATEGY ACTION PLAN

GOAL 1: Prevent Future Hazard Related Losses

Objective 1.1: Provide protection for future development to the extent possible

Mitigation Action 1.1.1: Increase restrictions to residential and commercial development in flood prone areas

Community: Essex County

Category: Prevention

Hazard: Flood

Background: The minimum requirements of the National Flood Insurance Program do not prohibit development within the 100-year floodplain. However, to adhere to the minimum federal requirements, the County requires development and new structures in the floodplain to meet certain flood protection measures, including elevating the first floor of structures to a minimum of one foot above the 100-year flood elevations and utilizing flood-proof construction techniques. Moreover, where alternative building sites on a parcel are available for construction outside the 100-year floodplain, construction outside of the floodplain is preferred. Essex County can reduce flood damage for future development by revising the Land Use Plan Element of the Essex County Comprehensive Plan to direct future growth outside of the 100-year floodplain.

Priority: Moderate

Responsible Office: County Administration Office

Cost Estimate: Staff time and production budget

Cost Benefit: The cost of building structures outside of the floodplain and not having to incorporate flood protection measures could be lower than the cost required for incorporating flood protection measures into construction. This could also lead to an eventual reduction in flood insurance premiums for the community.

Potential Funding: Local operating budget

Schedule: Implemented at next land use plan re-evaluation

Mitigation Action 1.1.2: Increase the Flood Protection Elevation (FPE) requirement in the Essex County Floodplain Ordinance from 7 feet to 8 to 8.5 feet. New structures built within the Special Flood Hazard Area in Essex County should be built such that the freeboard on the lowest floor of the structure is at a minimum 8 feet in elevation.

Community: Essex County

Category: Prevention, Property Protection

Hazard: Flood

Background: To avoid the hassle of elevating flood prone structures in the future, increasing the required Base Flood Elevation by 1 to 1.5 feet into the Floodplain Management Ordinance, thereby formalizing it, would be beneficial in a number of ways. First, it would provide structures with a greater degree of safety during flood events. Second, it would allow for more Community Rating System (CRS) points as the ordinance would be more stringent than the minimum FEMA standard.

Priority: High

Responsible Office: County Administration Office, FEMA

Cost Estimate: To the County, cost would be in staff time and production budget; To the homeowner, additional cost of elevation.

Cost Benefit: With the investment of upfront cost of building structures at a slightly higher elevation, an eventual reduction in flood insurance premiums to the community by increasing the County's CRS rating is probable.

Potential Funding: Federal Grants

Schedule: As soon as possible

Mitigation Action 1.1.3: Amend the Middlesex County Floodplain Ordinance to require new construction to include a Flood Protection Elevation (FPE) requirement. New structures in the Special Flood Hazard Area in Middlesex County should be built such that the freeboard on the lowest floor of the structure is a minimum of 1 foot above the 100-year frequency flood or Base Flood Elevation (BFE + 1).

Community: Middlesex County

Category: Prevention

Hazard: Flood

Background: To avoid the hassle of elevating flood prone structures in the future, writing BFE + 1 into the Floodplain Management Ordinance, thereby formalizing it, would be beneficial in a number of ways. First, it would provide structures with a greater degree of safety during flood events. Second, it would allow for more Community Rating System (CRS) points as the ordinance would be more stringent than the minimum FEMA standard.

Priority: High

Responsible Office: County Administration Office

Cost Estimate: To the County, cost would be in staff time and production budget; To the homeowner, it would cost approximately $3000 for the additional foot of elevation.

Cost Benefit: With the investment of upfront cost of building structures at a slightly higher elevation, an eventual reduction in flood insurance premiums to the community by increasing the County's CRS rating is probable.

Potential Funding: None necessary

Schedule: Implemented at next land use plan re-evaluation

Mitigation Action 1.1.4: Amend the Town of West Point Floodplain Ordinance to require new construction to include a Flood Protection Elevation (FPE) requirement. New structures in the Special Flood Hazard Area in the Town of West Point should be built such that the freeboard on the lowest floor of the structure is a minimum of 1 foot above the 100-year frequency flood or Base Flood Elevation (BFE + 1).

Community: Town of West Point

Category: Prevention

Hazard: Flood

Background: To avoid the hassle of elevating flood prone structures in the future, writing BFE + 1 into the Floodplain Management Ordinance, thereby formalizing it, would be beneficial in a number of ways. First, it would provide structures with a greater degree of safety during flood events. Second, it would allow for more Community Rating System (CRS) points as the ordinance would be more stringent than the minimum FEMA standard.

Priority: High

Responsible Office: Town Administration Office

Cost Estimate: To the Town, cost would be in staff time and production budget; To the homeowner, it would cost approximately $3000 for the additional foot of elevation.

Cost Benefit: With the investment of upfront cost of building structures at a slightly higher elevation, an eventual reduction in flood insurance premiums to the community by increasing the Town's CRS rating is probable.

Potential Funding: None necessary

Schedule: As soon as possible

Mitigation Action 1.1.5: Repair dry hydrants throughout the County.

Community: King William County

Category: Property Protection

Hazard: Wildfire

Background: A dry hydrant is a non-pressurized pipe system permanently installed in existing lakes, ponds and streams that provides a suction supply of water to a fire department tank truck. In rural areas, a lack of water mains and pressurized fire hydrants can sometimes impair a fire department's ability to do its job quickly and efficiently. The success of a fire department's operation hinges on the distance a truck must travel to fill-up and return to the fire. In many cases these fill-up points are often long distances from the fire and the firefighters are unable to maintain an uninterrupted water source at the scene. The instillation of a non-pressurized pipe system into local water sources provides a ready means of supplying water to fire engines. NFPA 1142 "Standard on Water Supplies for Suburban & Rural Fire Fighting" outlines planning, permits, design, and installation of dry hydrant systems. There were six dry hydrant stations in King William County. All six have been destroyed since 2003 by the effects of Hurricane Isabel (2003) and Tropical Storm Gaston (2004).

Priority: High

Responsible Office: King William County Public Safety Division

Cost Estimate: $250,000

Cost Benefit: These hydrants will once again provide the County with more adequate water supplies for fire suppression needs. Once in place, King William County Fire Departments will not need to shuttle water by tanker from municipal water towers to the fire scene, but can access water via the closest dry hydrant. This can decrease response time to wildfire emergencies.

Potential Funding: Virginia Department of Forestry Dry Hydrant Grant Program (also funds *repairs* of existing dry fire hydrants)

Schedule: As soon as funding is secured (next grant deadline is May 13, 2005)

Mitigation Action 1.1.6: Repair dams on ponds destroyed by Tropical Storm Gaston and install dry hydrants on each.

Community: King William County

Category: Property Protection

Hazard: Wildfire

Background: As described in the Background information in Mitigation Action 1.1.4, dry hydrants provide rural King William County with more adequate water supplies for fire suppression needs. Two ponds, Mitchell's Mill Pond on Route 610 and Herring Creek Mill Pond, were destroyed when their dams broke following the intense rains of Tropical Storm Gaston in 2004. These ponds provided water to dry hydrant systems, but after the dams retaining the ponds were compromised, there is no water available to feed these dry hydrants. The roads along these dams are also closed to traffic.

Priority: High

Responsible Office: King William County Public Safety Division

Cost Estimate: $25,000-$200,000+ per dam repair

Cost Benefit: These ponds and dry hydrants will once again provide the County with more adequate water supplies for fire suppression needs. Once in place, King William County Fire Departments will not need to shuttle water by tanker from municipal water towers to the fire scene, but can access water via the closest dry hydrant. This can decrease response time to wildfire emergencies.

Potential Funding: Hazard Mitigation Grant Funds and Virginia Department of Forestry Dry Hydrant Grant Funds

Schedule: As soon as funding is secured (next grant deadline for the VDOF grant program is May 13, 2005)

Objective 1.2: Provide protection for Critical Public Facilities and Services

Mitigation Action 1.2.1: Install flood protection where appropriate

Community: Town of Tappahannock

Category: Prevention, Natural Resources Protection

Hazard: Flood, Hurricanes, Ice Storms

Background: Communities need to maintain their ability to respond and recover from disasters by maintaining an operation facility. The sewage pump station at Nebill Drive is located within the floodplain and becomes inundated and non-functional during flooding events. Elevating this pump station would protect it from failing during future flood events and prevent raw sewage from overflowing into the Rappahannock River.

Priority: Moderate

Responsible Office: Town Administration Office

Cost Estimate: Combined with mitigation action 1.2.2, total project budget is estimated at $1 million

Cost Benefit: As stated above in the mitigation background section, the investment in flood protection of this critical public facility will help prevent future damage and allow it to remain functional during times of emergency.

Potential Funding: Match grants

Schedule: Implemented by 2010

Mitigation Action 1.2.2: Install flood protection where appropriate

Community: Mathews County

Category: Prevention, Natural Resources Protection

Hazard: Flood, Hurricanes, Ice Storms

Background: Communities need to maintain their ability to respond and recover from disasters by maintaining an operation facility. The Hampton Roads Sanitation District sewage treatment station at Mathews Courthouse on Put-In Creek is located within the floodplain and becomes inundated and non-functional during flooding events. Relocating this sewage treatment facility outside of the floodplain would protect County residents from the health hazards and the natural resources of Put-In Creek and surrounding waterways from contamination associated with raw sewage overflowing into Put-In Creek.

Priority: High

Responsible Office: Hampton Roads Sanitation District and Mathews County Administration Office

Cost Estimate: $1.5 – 2.0 million

Cost Benefit: As stated above in the mitigation background section, the investment in relocating this critical public facility will allow it to remain functional during times of emergency and prevent future environmental degradation of Chesapeake Bay tributaries from the overflow of nutrients to the system from a sewage spill.

Potential Funding: Federal grant funding (submitted a proposal to the Virginia Post-Hazard Mitigation Grant program in 2004, but project exceeded the budget of available funding)

Schedule: As soon as possible

Mitigation Action 1.2.3: Install back-up power where appropriate

Community: Town of Tappahannock

Category: Emergency Services

Hazard: Flood, Hurricanes, Ice Storms

Background: Communities need to maintain their ability to respond and recover from disasters by maintaining an operation facility. The sewage pump stations at Essex Street, Cross Street, Old Creek Lake Drive, and Hoskins Creek at Route 17 do not currently have emergency back-up power supplies. In the event of a power outage, these pump stations run the risk of allowing raw sewage to flow into the Rappahannock River. Installation of a back-up generator on each of these Town pump stations would maintain sewage treatment function during power outages.

Priority: Moderate

Responsible Office: Town Administration Office

Cost Estimate: combined with mitigation action 1.2.1, total project budget is estimated at $1 million

Cost Benefit: As stated above in the mitigation background section, the investment in back-up power supply of these critical public facilities will help prevent future damage to the natural resources of the Rappahannock River and to the health of Town residents from raw sewage overflow in the event of a power outage. Installation of back-up power supplies will allow these sewage pump stations to remain functional during times of emergency.

Potential Funding: Match grants

Schedule: Implemented by 2010

Mitigation Action 1.2.4: Install back-up power where appropriate

Community: Town of Urbanna

Category: Emergency Services

Hazard: Flood, Hurricanes, Ice Storms

Background: Communities need to maintain their ability to respond and recover from disasters by maintaining an operation facility. The Town of Urbanna is served by a 250,000 gallon water tower fed from a public water well. The well pump lacks sufficient back-up power to remain functional in the event of an extended power outage. Without back-up power, the water supply in the tower reservoir will only provide approximately 1.5 days of water service to the Town. Installing a back-up power generator would allow for replenishment of the Town's water supply in the event of an extended power outage, therefore maintaining the supply of water to the Town and its residents throughout an emergency when electric power to the Town is interrupted.

Priority: High

Responsible Office: Town Administration Office (G. Lewis Filling, Town Manager)

Cost Estimate: $19,200

Cost Benefit: As stated above in the mitigation background section, the investment in back-up power supply of this critical public facility will allow it to remain functional during times of emergency.

Potential Funding: Grant funding and Town taxes

Schedule: As soon as possible (within six months)

Mitigation Action 1.2.5: Install back-up power where appropriate

Community: Town of West Point

Category: Emergency Services

Hazard: Flood, Hurricanes, Ice Storms

Background: Communities need to maintain their ability to respond and recover from disasters by maintaining an operation facility. West Point High School is an American Red Cross-approved emergency shelter, but it lacks a permanently-installed back-up generator to supply power to the building in the event of an extended power outage. Installing a back-up power generator would increase the power-generating capacity for the shelter and allow one of the Town's portable generators to be placed at another location (such as the public works building, police station, or public water supply well pumps).

Priority: High

Responsible Office: Town Administration Office (Trenton Funkhouser, Town Manager)

Cost Estimate: $100,000

Cost Benefit: As stated above in the mitigation background section, the investment in back-up power supply of this critical public facility will allow it to remain functional during times of emergency.

Potential Funding: Grant funding and Town taxes

Schedule: As soon as possible (within six months)

Mitigation Action 1.2.6: Install back-up power where appropriate

Community: Town of West Point

Category: Emergency Services

Hazard: Flood, Hurricanes, Ice Storms

Background: Communities need to maintain their ability to respond and recover from disasters by maintaining an operation facility. The Town of West Point intends to install a permanently-mounted back-up generator to supply power to public water supply wells #2 (at West Point High School) and #3 (at Chelsea Road) to maintain the Town's water supply to residents in the event of an extended power outage. Installing a permanently-mounted back-up power generator to these facilities would increase allow one of the Town's portable generators to be placed at another location (such as the public works building, police station, or another public water supply well pump).

Priority: High

Responsible Office: Town Administration Office (Trenton Funkhouser, Town Manager)

Cost Estimate: $40,000

Cost Benefit: As stated above in the mitigation background section, the investment in back-up power supply of this critical public facility will allow it to remain functional during times of emergency.

Potential Funding: Grant funding and Town taxes

Schedule: As soon as possible (within six months)

GOAL 2: Improve Community Emergency Management Capability

Objective 2.1: Improve ability to communicate to residents and businesses during and following emergencies and disasters

Mitigation Action 2.1.1: Install a public warning system (reverse 911)

Community: Essex County

Category: Emergency Services

Hazard: multiple hazards

Background: The high speed Emergency Notification System (Reverse 911) is a state-of-the-art telephone system that can rapidly alert residents in a targeted area of impending dangers on emergencies. This system can communicate watches, warnings, and other important time-sensitive information from local governments and public safety agencies simultaneously to large groups of residents. The system will allow geographical selection of targeted notification areas, including homes, businesses, hospitals, etc. The County currently does not have a way to rapidly warn residents, other than through the local radio stations, of possible danger to lives or property when warnings are received from the National Weather Service or other sources. No television stations are located in the Middle Peninsula that could provide this information to residents.

Priority: High

Responsible Office: County Administration Office (Emergency Management Coordinator)

Cost Estimate: approximately $30,000

Cost Benefit: This project will benefit the community by increasing public safety due to the improved ability to provide effective early warning alerts of impending dangers. The system also can be used to call response personnel and deliver incident-specific information or instructions, with confirmation of message receipt through a touch-tone response. The benefit will be a safer public because of more effective and encompassing warning and information system.

Potential Funding: Funds will be sought through grants, including the FEMA Hazard Mitigation Grant Program

Schedule: within a year

Mitigation Action 2.1.2: Install a public warning system (reverse 911)

Community: Town of Tappahannock

Category: Emergency Services

Hazard: multiple hazards

Background: The high speed Emergency Notification System (Reverse 911) is a state-of-the-art telephone system that can rapidly alert residents in a targeted area of impending dangers on emergencies. This system can communicate watches, warnings, and other important time-sensitive information from local governments and public safety agencies simultaneously to large groups of residents. The system will allow geographical selection of targeted notification areas, including homes, businesses, hospitals, etc. The Town currently does not have a way to rapidly warn residents, other than through the local radio stations, of possible danger to lives or property when warnings are received from the National Weather Service or other sources. No television stations are located in the Middle Peninsula that could provide this information to residents.

Priority: High

Responsible Office: Town Administration Office (Emergency Management Coordinator)

Cost Estimate: approximately $20,000

Cost Benefit: This project will benefit the community by increasing public safety due to the improved ability to provide effective early warning alerts of impending dangers. The system also can be used to call response personnel and deliver incident-specific information or instructions, with confirmation of message receipt through a touch-tone response. The benefit will be a safer public because of more effective and encompassing warning and information system.

Potential Funding: Funds will be sought through grants, including the FEMA Hazard Mitigation Grant Program

Schedule: within a year

Mitigation Action 2.1.3: Install a public warning system (reverse 911)

Community: King and Queen County

Category: Emergency Services

Hazard: multiple hazards

Background: The high speed Emergency Notification System (Reverse 911) is a state-of-the-art telephone system that can rapidly alert residents in a targeted area of impending dangers on emergencies. This system can communicate watches, warnings, and other important time-sensitive information from local governments and public safety agencies simultaneously to large groups of residents. The system will allow geographical selection of targeted notification areas, including homes, businesses, hospitals, etc. The County currently does not have a way to rapidly warn residents, other than through the local radio stations, of possible danger to lives or property when warnings are received from the National Weather Service or other sources. No television stations are located in the Middle Peninsula that could provide this information to residents.

Priority: High

Responsible Office: County Administration Office (Emergency Management Coordinator)

Cost Estimate: approximately $30,000

Cost Benefit: This project will benefit the community by increasing public safety due to the improved ability to provide effective early warning alerts of impending dangers. The system also can be used to call response personnel and deliver incident-specific information or instructions, with confirmation of message receipt through a touch-tone response. The benefit will be a safer public because of more effective and encompassing warning and information system.

Potential Funding: Funds will be sought through grants, including the FEMA Hazard Mitigation Grant Program

Schedule: within a year

Mitigation Action 2.1.4: Install a public warning system (reverse 911)

Community: King William County

Category: Emergency Services

Hazard: multiple hazards

Background: The high speed Emergency Notification System (Reverse 911) is a state-of-the-art telephone system that can rapidly alert residents in a targeted area of impending dangers on emergencies. This system can communicate watches, warnings, and other important time-sensitive information from local governments and public safety agencies simultaneously to large groups of residents. The system will allow geographical selection of targeted notification areas, including homes, businesses, hospitals, etc. The County currently does not have a way to rapidly warn residents, other than through the local radio stations, of possible danger to lives or property when warnings are received from the National Weather Service or other sources. No television stations are located in the Middle Peninsula that could provide this information to residents.

Priority: High

Responsible Office: County Administration Office (Emergency Management Coordinator)

Cost Estimate: approximately $30,000

Cost Benefit: This project will benefit the community by increasing public safety due to the improved ability to provide effective early warning alerts of impending dangers. The system also can be used to call response personnel and deliver incident-specific information or instructions, with confirmation of message receipt through a touch-tone response. The benefit will be a safer public because of more effective and encompassing warning and information system.

Potential Funding: Funds will be sought through grants, including the FEMA Hazard Mitigation Grant Program

Schedule: within a year

Mitigation Action 2.1.5: Install a public warning system (reverse 911)

Community: Town of West Point

Category: Emergency Services

Hazard: multiple hazards

Background: The high speed Emergency Notification System (Reverse 911) is a state-of-the-art telephone system that can rapidly alert residents in a targeted area of impending dangers on emergencies. This system can communicate watches, warnings, and other important time-sensitive information from local governments and public safety agencies simultaneously to large groups of residents. The system will allow geographical selection of targeted notification areas, including homes, businesses, hospitals, etc. The Town currently does not have a way to rapidly warn residents, other than through the local radio stations, of possible danger to lives or property when warnings are received from the National Weather Service or other sources. No television stations are located in the Middle Peninsula that could provide this information to residents.

Priority: High

Responsible Office: Town Administration Office

Cost Estimate: approximately $20,000

Cost Benefit: This project will benefit the community by increasing public safety due to the improved ability to provide effective early warning alerts of impending dangers. The system also can be used to call response personnel and deliver incident-specific information or instructions, with confirmation of message receipt through a touch-tone response. The benefit will be a safer public because of more effective and encompassing warning and information system.

Potential Funding: Funds will be sought through grants, including the FEMA Hazard Mitigation Grant Program

Schedule: within a year

Mitigation Action 2.1.6: Install a public warning system (reverse 911)

Community: Mathews County

Category: Emergency Services

Hazard: multiple hazards

Background: The high speed Emergency Notification System (Reverse 911) is a state-of-the-art telephone system that can rapidly alert residents in a targeted area of impending dangers on emergencies. This system can communicate watches, warnings, and other important time-sensitive information from local governments and public safety agencies simultaneously to large groups of residents. The system will allow geographical selection of targeted notification areas, including homes, businesses, hospitals, etc. The County currently does not have a way to rapidly warn residents, other than through the local radio stations, of possible danger to lives or property when warnings are received from the National Weather Service or other sources. No television stations are located in the Middle Peninsula that could provide this information to residents.

Priority: High

Responsible Office: County Administration Office (Emergency Management Coordinator)

Cost Estimate: approximately $30,000

Cost Benefit: This project will benefit the community by increasing public safety due to the improved ability to provide effective early warning alerts of impending dangers. The system also can be used to call response personnel and deliver incident-specific information or instructions, with confirmation of message receipt through a touch-tone response. The benefit will be a safer public because of more effective and encompassing warning and information system.

Potential Funding: Funds will be sought through grants, including the FEMA Hazard Mitigation Grant Program

Schedule: within a year

Improve Mapping Capabilities

Mitigation Action 2.1.6.A: Update to high-resolution aerial orthophotography for mapping data for Mathews County Geographic Information System (GIS)

Community: Mathews County

Category: Emergency Services

Hazard: multiple hazards, including flooding

Background: In 2001 the Advisory Board of the Virginia Geographic Information Network (VGIN, now a division of the Virginia Information Technologies Agency) entered into an agreement with the Wireless E911 Services Board and other state agencies to acquire high resolution digital orthophotography of the entire state. Rural areas of the Middle Peninsula were flown at 1:4800 ("400 scale") and more developed areas (population in a census block group greater than 100 persons per square mile) were flown at 1:2400 scale. Localities were given the option of upgrading the photography (at the difference in cost of acquisition) to either 1:2400 ("200 scale") or 1:1200 ("100 scale"). The State was flown in the first quarter of 2002 and data delivered to localities in 2003.

One of the products that were derived was a Digital Terrain Model (DTM) which can be used to generate contours for each area. The areas flown at 1:4800 scale are capable of generating 10 foot contours. The 1:2400 scale will provide 5 foot contours and the 1:1200 scale will generate 2 foot contours for an area.

VGIN is providing the DTMs to FEMA to generate new flood maps for localities. These will be more accurate than the current paper FIRM maps but there will be widely varying degrees of accuracy based on the scale at which an area was flown, especially in coastal areas and areas of deep ravines.

Upgrading the areas of the county currently photographed at "400 scale" to "200 scale" and those photographed at "200 scale" to "100 scale" could benefit this floodplain mapping effort and will provide more accurate GIS data for other mapping efforts such as the addressed structure E-911 database, coastal shoreline mapping, and land use planning projects.

Priority: High

Responsible Office: County Administration Office

Cost Estimate: The cost of upgrading the entire county to a single 200-scale dataset county wide, is estimated at $10,000; Localities will also have the option of upgrading to “100 scale” photography.

Cost Benefit: This project will benefit the community by increasing the Counties ability to map hazards and assess vulnerabilities of homes, businesses, and public facilities to hazards.

Potential Funding: Existing budgets and grants

Schedule: within two years

Mitigation Action 2.1.7: Install a public warning system (reverse 911)

Community: Middlesex County

Category: Emergency Services

Hazard: multiple hazards

Background: The high speed Emergency Notification System (Reverse 911) is a state-of-the-art telephone system that can rapidly alert residents in a targeted area of impending dangers on emergencies. This system can communicate watches, warnings, and other important time-sensitive information from local governments and public safety agencies simultaneously to large groups of residents. The system will allow geographical selection of targeted notification areas, including homes, businesses, hospitals, etc. The County currently does not have a way to rapidly warn residents, other than through the local radio stations, of possible danger to lives or property when warnings are received from the National Weather Service or other sources. No television stations are located in the Middle Peninsula that could provide this information to residents.

Priority: High

Responsible Office: County Administration Office (Emergency Management Coordinator)

Cost Estimate: approximately $30,000

Cost Benefit: This project will benefit the community by increasing public safety due to the improved ability to provide effective early warning alerts of impending dangers. The system also can be used to call response personnel and deliver incident-specific information or instructions, with confirmation of message receipt through a touch-tone response. The benefit will be a safer public because of more effective and encompassing warning and information system.

Potential Funding: Funds will be sought through grants, including the FEMA Hazard Mitigation Grant Program

Schedule: within a year

Mitigation Action 2.1.8: Install a public warning system (reverse 911)

Community: Town of Urbanna

Category: Emergency Services

Hazard: multiple hazards

Background: The high speed Emergency Notification System (Reverse 911) is a state-of-the-art telephone system that can rapidly alert residents in a targeted area of impending dangers on emergencies. This system can communicate watches, warnings, and other important time-sensitive information from local governments and public safety agencies simultaneously to large groups of residents. The system will allow geographical selection of targeted notification areas, including homes, businesses, hospitals, etc. The Town currently does not have a way to rapidly warn residents, other than through the local radio stations, of possible danger to lives or property when warnings are received from the National Weather Service or other sources. No television stations are located in the Middle Peninsula that could provide this information to residents.

Priority: High

Responsible Office: County Administration Office (Emergency Management Coordinator)

Cost Estimate: approximately $21,000

Cost Benefit: This project will benefit the community by increasing public safety due to the improved ability to provide effective early warning alerts of impending dangers. The system also can be used to call response personnel and deliver incident-specific information or instructions, with confirmation of message receipt through a touch-tone response. The benefit will be a safer public because of more effective and encompassing warning and information system.

Potential Funding: Funds will be sought through grants, including the FEMA Hazard Mitigation Grant Program, and from local funding sources
Schedule: within a year

Objective 2.2: Improve ability of locality to communicate with state Emergency Operations Center during state-and federally-declared disasters

Mitigation Action 2.2.1: Become an officially-recognized Independent Emergency Planning Area

Community: Town of West Point

Category: Emergency Services

Hazard: multiple hazards

Background: Although the Town of West Point has adopted an Emergency Operations Plan (EOP) and operates its own Fire and Rescue and Police Departments, the Town currently falls within the King William County Emergency Planning Area. In the event of a state- or federally-declared disaster, all emergency and disaster-related communication between the locality and the state Emergency Operations Center (EOC) must go through the officially-recognized emergency operations coordinator, the King William County Emergency Operations Coordinator. The Town of West Point would like to establish independence to become an Independent Emergency Planning Area

Priority: High

Responsible Office: Town Manager's Office

Cost Estimate: To the County, cost would be in staff time and production budget.

Cost Benefit: This project will benefit the community by increasing public safety due to the improved ability to provide effective communication between the State and Town. It will also alleviate the West Point responsibilities for the King William County Emergency Operations Coordinator and allow the County's Emergency Operations Center staff to focus on County residents' needs during a disaster.

Potential Funding: local funds

Schedule: within a year

GOAL 3: Increase Public Awareness of Vulnerability to Hazards

Objective 3.1: Provide information to residents and businesses about the types of hazards they are exposed to, where they occur, and what they can do to be better prepared

Mitigation Action 3.1.1: Form a committee that is responsible for providing the public with information regarding disasters, Floodplain Management, and preparedness.

Community: Essex County

Category: Emergency Services, Public Education

Hazard: multiple hazards

Background: Public education was a high priority to the Essex County Risk Assessment and Mitigation Planning Committee representatives when assembling the list of possible mitigation strategies. Public education can have numerous benefits ranging from public safety to public peace-of-mind. Public education can result in preventing or lessening damage caused by disasters and can save lives. Public education efforts can include (but is not limited to): understanding the public warning system and what to do when a warning is disseminated; preventing wildfires through the Virginia Department of Forestry's "Firewise Communities for Virginia" education program; Flood proofing structures appropriately; Property Protection Seminars; Hazard Awareness Fairs; Flood Zones; Surge Zones.

Priority: High

Responsible Office: County Administration Office (Emergency Management Coordinator)

Cost Estimate: staff time and production budget

Cost Benefit: This project will benefit the community by increasing public safety due to increased awareness of potential hazards in the area. The investment of time and minimal funds can raise public awareness in a number of important areas. Increased public awareness can lead to less property damage and greater public safety in emergency situations.

Potential Funding: Existing budgets

Schedule: within one year

Objective 3.2: Improve Mapping Capabilities

Mitigation Action 3.2.1: Update to high-resolution aerial orthophotography for mapping data on the Town's and County's Geographic Information System (GIS)

Community: Essex County and the Town of Tappahannock

Category: Emergency Services

Hazard: multiple hazards, including flooding

Background: In 2001 the Advisory Board of the Virginia Geographic Information Network (VGIN, now a division of the Virginia Information Technologies Agency) entered into an agreement with the Wireless E911 Services Board and other state agencies to acquire high resolution digital orthophotography of the entire state. Rural areas of the Middle Peninsula were flown at 1:4800 ("400 scale") and more developed areas (population in a census block group greater than 100 persons per square mile) were flown at 1:2400 scale. Localities were given the option of upgrading the photography (at the difference in cost of acquisition) to either 1:2400 ("200 scale") or 1:1200 ("100 scale"). The State was flown in the first quarter of 2002 and data delivered to localities in 2003.

One of the products that were derived was a Digital Terrain Model (DTM) which can be used to generate contours for each area. The areas flown at 1:4800 scale are capable of generating 10 foot contours. The 1:2400 scale will provide 5 foot contours and the 1:1200 scale will generate 2 foot contours for an area.

VGIN is providing the DTMs to FEMA to generate new flood maps for localities. These will be more accurate than the current paper FIRM maps but there will be widely varying degrees of accuracy based on the scale at which an area was flown, especially in coastal areas and areas of deep ravines.

Upgrading the areas of the county currently photographed at "400 scale" to "200 scale" and those photographed at "200 scale" to "100 scale" could benefit this floodplain mapping effort and will provide more accurate GIS data for other mapping efforts such as the addressed structure E-911 database, coastal shoreline mapping, and land use planning projects.

Priority: High

Responsible Office: County Administration Office and Town Manager Office

Cost Estimate: The cost of upgrading the entire county to a single 200-scale dataset county wide, is estimated at $100,284; Localities will also have the option of upgrading to “100 scale” photography. Upgrading the more densely-populated Town of Tappahannock to “100 scale” would cost an estimated $3,925.

Cost Benefit: This project will benefit the community by increasing the County and Town’s ability to map hazards and assess vulnerabilities of homes, businesses, and public facilities to hazards.

Potential Funding: Existing budgets and grants

Schedule: within two years

Mitigation Action 3.2.2: Update to high-resolution aerial orthophotography for mapping data on the County's Geographic Information System (GIS)

Community: King and Queen County

Category: Emergency Services

Hazard: multiple hazards, including flooding

Background: As described in the Background section of Mitigation Action 3.2.1, rural areas have the option of upgrading to high resolution digital orthophotography. Upgrading the areas of the county currently photographed at "400 scale" to "200 scale" and those photographed at "200 scale" to "100 scale" could benefit future floodplain mapping efforts and will provide more accurate GIS data for other mapping projects such as the addressed structure E-911 database, coastal shoreline mapping, and land use planning projects.

Priority: High

Responsible Office: County Administration Office

Cost Estimate: The cost of upgrading the entire county to a single 200-scale dataset county-wide, is estimated at $87, 960; If the County chooses to upgrade only the more densely-populated Route 33 corridor, the cost is estimated to be approximately $4,192.

Cost Benefit: This project will benefit the community by increasing the County's ability to map hazards and assess vulnerabilities of homes, businesses, and public facilities to hazards.

Potential Funding: Existing budgets and grants

Schedule: within two years

Mitigation Action 3.2.3: Update to high-resolution aerial orthophotography for mapping data on the County's Geographic Information System (GIS)

Community: Gloucester County

Category: Emergency Services

Hazard: multiple hazards, including flooding

Background: As described in the Background section of Mitigation Action 3.2.1, rural areas have the option of upgrading to high resolution digital orthophotography. Upgrading the areas of the county currently photographed at "400 scale" to "200 scale" and those photographed at "200 scale" to "100 scale" could benefit future floodplain mapping efforts and will provide more accurate GIS data for other mapping projects such as the addressed structure E-911 database, coastal shoreline mapping, and land use planning projects.

Priority: High

Responsible Office: County Administration Office

Cost Estimate: The cost of upgrading the entire county to a single 200-scale dataset county-wide, is estimated at $18,832.

Cost Benefit: This project will benefit the community by increasing the County's ability to map hazards and assess vulnerabilities of homes, businesses, and public facilities to hazards.

Potential Funding: Existing budgets and grants

Schedule: within two years

Mitigation Action 3.2.4: Update to high-resolution aerial orthophotography for mapping data on the Town's Geographic Information System (GIS)

Community: Town of West Point

Category: Emergency Services

Hazard: multiple hazards, including flooding

Background: As described in the Background section of Mitigation Action 3.2.1, rural areas have the option of upgrading to high resolution digital orthophotography. Upgrading the areas of the county currently photographed at "400 scale" to "200 scale" and those photographed at "200 scale" to "100 scale" could benefit future floodplain mapping efforts and will provide more accurate GIS data for other mapping projects such as the addressed structure E-911 database, coastal shoreline mapping, and land use planning projects.

Priority: High

Responsible Office: Town Manager's Office

Cost Estimate: The cost of upgrading the entire Town to a single 100-scale dataset, is estimated at $9,614.

Cost Benefit: This project will benefit the community by increasing the Town's ability to map hazards and assess vulnerabilities of homes, businesses, and public facilities to hazards.

Potential Funding: Existing budgets and grants

Schedule: within two years

Mitigation Action 3.2.5: Update to high-resolution aerial orthophotography for mapping data on the County's Geographic Information System (GIS)

Community: Middlesex County

Category: Emergency Services

Hazard: multiple hazards, including flooding

Background: As described in the Background section of Mitigation Action 3.2.1, rural areas have the option of upgrading to high resolution digital orthophotography. Upgrading the areas of the county currently photographed at "400 scale" to "200 scale" and those photographed at "200 scale" to "100 scale" could benefit future floodplain mapping efforts and will provide more accurate GIS data for other mapping projects such as the addressed structure E-911 database, coastal shoreline mapping, and land use planning projects.

Priority: High

Responsible Office: County Administration Office

Cost Estimate: The cost of upgrading the entire county to a single 200-scale dataset county-wide, is estimated at $23,312.

Cost Benefit: This project will benefit the community by increasing the County's ability to map hazards and assess vulnerabilities of homes, businesses, and public facilities to hazards.

Potential Funding: Existing budgets and grants

Schedule: within two years

Mitigation Action 3.2.6: Update to high-resolution aerial orthophotography for mapping data on the Town's Geographic Information System (GIS)

Community: Town of Urbanna

Category: Emergency Services

Hazard: multiple hazards, including flooding

Background: As described in the Background section of Mitigation Action 3.2.1, rural areas have the option of upgrading to high resolution digital orthophotography. Upgrading the areas of the county currently photographed at "400 scale" to "200 scale" and those photographed at "200 scale" to "100 scale" could benefit future floodplain mapping efforts and will provide more accurate GIS data for other mapping projects such as the addressed structure E-911 database, coastal shoreline mapping, and land use planning projects.

Priority: High

Responsible Office: Town Manager's Office

Cost Estimate: The cost of upgrading the entire Town to a single 100-scale dataset, is estimated at $2,530.

Cost Benefit: This project will benefit the community by increasing the Town's ability to map hazards and assess vulnerabilities of homes, businesses, and public facilities to hazards.

Potential Funding: Existing budgets and grants

Schedule: within two years

Objective 3.3: Improve Hurricane Storm Surge Mapping Capabilities

Mitigation Action 3.3.1: Create Hurricane Storm Surge maps for King William County and the Town of West Point.

Community: King William County and the Town of West Point

Category: Emergency Services

Hazard: hurricane

Background: Hurricane storm inundation information was developed as part of the Virginia Hurricane Evacuation Study for the Tidewater and Hampton Roads region. Although all Middle Peninsula localities experienced storm surge during Hurricane Isabel in September 2003, the only Middle Peninsula jurisdictions with available surge maps were the Counties of Gloucester, Mathews, and Middlesex. King William County and the Town of West Point would like to encourage FEMA and the U.S. Army Corps of Engineers to include King William and the Town of West Point in future Hurricane Storm Surge Mapping efforts.

Priority: High

Responsible Office: County Administration Office and Town Manager Office

Cost Estimate: $75,000+

Cost Benefit: This project will benefit the community by increasing the County and Town's ability to map hazards and assess vulnerabilities of homes, businesses, and public facilities to hazards. Maps will be developed to provide these local governments and citizens with the best and most current information available about coastal flood hazards to assist in the rebuilding process following a disaster.

Potential Funding: Federal funding from FEMA, U.S. Army Corps of Engineers

Schedule: Within two years

Mitigation Action 3.3.2: Update Hurricane Storm Surge maps for Middlesex County

Community: Middlesex County

Category: Emergency Services

Hazard: hurricane

Background: Hurricane storm inundation information was developed as part of the Virginia Hurricane Evacuation Study for the Tidewater and Hampton Roads region. Although all Middle Peninsula localities experienced storm surge during Hurricane Isabel in September 2003, the only Middle Peninsula jurisdictions with available surge maps were the Counties of Gloucester, Mathews, and Middlesex. The most current Hurricane Surge Map available for Middlesex County was released in 1994. Middlesex County would like to encourage FEMA and the U.S. Army Corps of Engineers to update the storm surge maps for Middlesex County and make them available in a digital format so that they may be integrated in the County's Geographic Information System (GIS).

Priority: High

Responsible Office: County Administration Office

Cost Estimate: $50,000+

Cost Benefit: This project will benefit the community by increasing the County and Town's ability to map hazards and assess vulnerabilities of homes, businesses, and public facilities to hazards. Maps will be developed to provide these local governments and citizens with the best and most current information available about coastal flood hazards to assist in the rebuilding process following a disaster.

Potential Funding: Federal funding from FEMA, U.S. Army Corps of Engineers

Schedule: Within two years

8. Plan Implementation and Maintenance

The implementation of the Plan shall be an ongoing effort on the part of the Middle Peninsula Risk Assessment and Mitigation Planning (RAMP) Committee, The Middle Peninsula Planning District Commission (MPPDC), and Boards of Supervisors and Town Councils of each Middle Peninsula Locality. Each Middle Peninsula locality shall formally adopt the Plan document to remain compliant with the Disaster Mitigation Act of 2000. Each Locality shall be responsible for monitoring Plan maintenance and reporting with respect to such conformity and/or divergences as necessary to the Virginia Department of Emergency Management (VDEM) periodically. Such reports shall be incorporated into the Local Government Administrators' Meeting agendas and conveyed to the MPPDC Director as necessary.

Plan maintenance implies an ongoing effort to monitor and evaluate the implementation of the Plan, update the Plan as progress, roadblocks, or changing circumstances are recognized. This monitoring and updating shall take place through an annual review by the RAMP Committee and a 5-year written update to be submitted to VDEM and FEMA Region III, unless disaster or other circumstances (e.g. changing regulations) lead to a different timeframe.

With respect to any ongoing mitigation activity, the lead and support agencies for such activity shall be tasked with implementing the Plan's Goals and Objectives and monitoring compliance. All lead and support agencies shall be requested to identify an individual Point of Contact (POC). The POC shall convene with, and/or report to VDEM periodically as to the activity's progress and compliance with the Goals and Objectives of the Plan.

Monitoring funding opportunities should continue to assist in leveraging and implementing some of the more costly mitigation action recommendations. A bank of ideas on how any required local match or participation requirements can be met should be created and maintained. Being aware of funding as it becomes available will allow the RAMP Committee to take advantage of important opportunities. Funding opportunities that should be monitored include pre- and post-disaster funds, special regionally-budgeted funds, state or federally ear-marked funds, and grant programs, particularly those that may serve or support multi-objective applications.

When the RAMP Committee convenes for the annual review, they shall coordinate with all of the stakeholders that either participated or were invited to participate in the original Middle Peninsula Natural Hazard Mitigation Plan planning process, or have joined the RAMP Committee since the inception of the planning process. The goal of these meetings will be to update and revise the Plan. Public participation will once again be encouraged. The invitation to participate will be extended through web postings and press releases to local media outlets. The RAMP Committee should also continue to develop, review,

and promote mitigation proposals, to discuss stakeholder concerns about hazard mitigation, and to maintain the Middle Peninsula Regional Natural Hazard Mitigation Plan website (housed at the MPPDC). Locality representatives to the regional RAMP Committee should pass on this information to their locality's governing board.

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Middle Peninsula Regional Natural Hazards Mitigation Plan

Appendices

Appendix 1: The Middle Peninsula Risk Assessment and Mitigation Planning (RAMP) Advisory Committee

The Middle Peninsula Risk Assessment and Mitigation Planning (RAMP) Advisory Committee, made up of public representatives and organizations from each of the six counties and three towns that make up the Middle Peninsula, was brought together to provide input to Middle Peninsula Planning District Commission staff during the plan development process. Efforts to involve county and town departments, utility companies, and other community organizations that might have a role in the implementation of mitigation actions or policies included invitations to attend meetings and serve on the RAMP, e-mails of meeting minutes and links to presentation slide shows and meeting summaries posted on the Middle Peninsula Regional Hazard Mitigation Plan website, and opportunities for input and to comment on all draft deliverables.

The Middle Peninsula Planning District Commission would like to thank and acknowledge the following individuals who served on the RAMP Advisory Committee and provided information for their representative localities and organizations throughout the planning process:

Locality Representatives:

Name	Title
ESSEX COUNTY	
R. Gary Allen	County Administrator
Larry E. Smith	Emergency Management Coordinator/Hazardous Materials Coordinator
James W. Snydor	Planning Commission Chairman
GLOUCESTER COUNTY	
Georgette Hurley	Assistant County Administrator
Tracy Proctor	Sheriff's Department
Jay Scudder	Planning Director
Rita Taylor	GIS Analyst
Mark Westfall	Emergency Coordinator
KING & QUEEN COUNTY	
Ron Hachey	County Administrator
Paul F. Koll	Building & Zoning Department
Carissa Lee	Planner
Holly McGowan	Planner
KING WILLIAM COUNTY	
Gina Beale	GIS Coordinator
Betty Brooks	GIS/Planning Technician
Lewis E. Heath	Emergency Management Coordinator/ Hazardous Materials Coordinator

Locality Representatives (continued):

MATHEWS COUNTY	
April Branton	GIS Coordinator
Stephen K. Whiteway	Mathews County Administrator
MIDDLESEX COUNTY	
Amy Easterbrook	Planner
Kevin Jordan	E911 Coordinator
Betty Muncy	Administrative Secretary
Lee Weber	Emergency Management Director
TOWN OF TAPPAHANNOCK	
G. Gayle Belfield	Town Manager, Planning Director
TOWN OF URBANNA	
Lewis Filling	Town Manager
TOWN OF WEST POINT	
Claire Jones	Director of Community Development
Trenton Funkhouser	Town Manager

Regional Interest Representatives:

Name	**Title**
T. Stewart Baker	VDEM Hurricane Program Manager
Tom Bernard	Emergency Planner, Three Rivers Health District
Dave Corzilius	VDEM Mitigation Planning Coordinator
Carlton L. Dudding	General Manager, BFI Waste Services of Richmond
Tim Gaylord	Airport Director, Middle Peninsula Regional Airport
Tom Grose	Safety Officer, Virginia Institute of Marine Science
Tommy Harmon	Rappahannock Electric Cooperative
Lewis Lawrence	MPPDC Regional Projects Director
Tim Loveland	Waste Management; Middle Peninsula Sanitary Landfill & Recycling Center
Hugh Markham	Watershed Coordinator, Tidewater RC&D
Curt Nellis	VDEM Regional Coordinator, Region I
Janet Nestlerode	MPPDC All Hazards Planner
Jim Pyne	Manager, Small Communities Division, Hampton Roads Sanitation District
JoAnn Ruffa	Project Rebound, Middle Peninsula-Northern Neck Community Services Board
Wallace Twigg	VDEM Regional Coordinator, Region V
Dr. Reuben Varghese	District Director, Three Rivers Health District

Appendix 2: The Middle Peninsula Natural Hazard Mitigation Plan Public Input Meeting Newspaper Ad

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teach Sunday School
is an Elder.
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Chairman Pete Trible
3 for more information.

M Meeting
or March 5

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Measures will hold its
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at 2 p.m., in the Essex
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lic is invited. For more
n call Harrison Long at
-8248.

Relay for Life captains meeting will be held Thursday, March 3, at 5:30 p.m. at Ferebee's Restaurant in Tappahannock.

Anyone interested in having a team is invited to attend.

****
"TN'L THE PLACE TO BE"
1309 Tappahannock Blvd., Tappahannock
443-5959

MIDDLE PENINSULA REGIONAL ALL-HAZARD MITIGATION PLAN

A Public Meeting will be held to review and seek public input to the Regional Natural Hazard Mitigation Plan

Wednesday, March 9, 2005
Middle Peninsula Planning District Commission Office, Saluda, Virginia
1:00 - 3:00 p.m.

- The federal Disaster Mitigation Act (DMA) of 2000 requires all communities nationwide to adopt a natural hazard mitigation plan to remain eligible for hazard-related federal assistance.
- The Middle Peninsula was one of the first areas in the state to address this mandate and is in final stages of developing our region's plan.
- The Regional Natural Hazard Mitigation Plan identifies hazards, assesses vulnerabilities and potential losses, and sets mitigation goals for Middle Peninsula localities.
- A draft of the Hazard Mitigation Plan is available on-line for review at *www.mppdc.com/ahmp/plan.pdf*
- Interested Middle Peninsula citizens are encouraged to attend
- For more information, contact Janet Nestlerode, MPPDC, 804-758-2311

VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT

Middle Peninsula Planning District Commission

The Middle Peninsula All Hazard Mitigation Plan is funded through a grant to the Middle Peninsula Planning District Commission from the Virginia Department of Emergency Management

Appendix 3: Middlesex Snow Cover History

Extension Service
West Virginia University

Snow Cover History

Dr. Edward B. Rayburn, Extension Forage Agronomist
Dr. John Lozier, Research Assistant, WVU Extension Service

June 2001

Middlesex County, Virginia
Urbanna Station #8642

Year	Date of first snow cover greater than ...		Date of last snow cover greater than ...		Days of snow cover greater than ...		January median temp.	Comments
	1 inch	8 inches	8 inches	1 inch	1 inch	8 inches		
49-50	2/26/50			3/16/50	2		49.4	
50-51	2/7/51			2/7/51	1		42.1	
51-52	2/27/52			2/27/52	1		44.0	
52-53	3/2/53			3/3/53	2		44.4	
53-54	1/22/54			1/24/54	3		39.1	
54-55	12/6/54			1/14/55	7		37.3	
55-56	1/7/56			1/7/56	1		35.9	
56-57	1/14/57			1/20/57	6		37.0	
57-58	1/7/58			3/9/58	8		34.6	
58-59	12/11/58	12/14/58	12/16/58	1/17/59	13	3	37.9	
59-60	2/13/60			3/16/60	16		38.7	
60-61	12/12/60			2/8/61	13		32.9	
61-62	1/1/62			2/2/62	10		37.8	
62-63	12/21/62			2/27/63	3		36.4	
63-64	12/18/63			3/30/64	12		39.5	
64-65	1/16/65			2/15/65	12		38.0	
65-66	1/16/66	1/26/66	2/9/66	2/10/66	18	15	33.8	
66-67	12/23/66			2/19/67	17		41.4	
67-68	12/23/67			3/1/68	9		31.6	
68-69	12/8/68			3/9/69	4		35.7	
69-70	1/7/70			2/4/70	9		32.4	
70-71	1/1/71			3/26/71	5		34.6	
71-72	2/19/72			2/19/72	1		42.5	
72-73	1/7/73			1/14/73	8		33.6	
Median Values								
	7-Jan	**4-Jan**	**12-Jan**	**17-Feb**	**7.5**	**9**	**37.6**	

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Appendix 4: King and Queen Snow Cover History

Extension Service
West Virginia University

Snow Cover History

Dr. Edward B. Rayburn, Extension Forage Agronomist
Dr. John Lozier, Research Assistant, WVU Extension Service

June 2001

King & Queen County, Virginia
Walkerton Station #8829

Year	Date of first snow cover greater than ...		Date of last snow cover greater than ...		Days of snow cover greater than ...		January median temp.	Comments
	1 inch	8 inches	8 inches	1 inch	1 inch	8 inches		
31-32								no snow cover
32-33	12/17/32	12/17/32	12/17/32	2/11/33	12	1	44.5	
33-34	2/9/34			3/23/34	9		38.5	
34-35	12/10/34			2/1/35	13		32.7	
35-36	12/22/35	12/30/35	2/9/36	2/14/36	26	4	10.4	
36-37	2/16/37			3/15/37	3		46.1	
37-38	12/13/37			1/19/38	2		37.5	
38-39	11/24/38			11/28/38	5		40.6	
39-40	12/27/39	1/24/40	2/3/40	2/7/40	22	11	16.8	
40-41	2/28/41			3/7/41	2		31.8	
41-42	1/8/42			1/12/42	4		34.8	
42-43	12/20/42			3/21/43	4		39.5	
43-44	12/29/43			2/9/44	6		37.8	
44-45							34.2	no snow cover
45-46	12/10/45			1/27/46	11		38.5	
46-47	1/1/47			3/10/47	15		43.9	
47-48	1/18/48			2/22/48	19		30.1	
48-49							45.8	no snow cover
49-50	2/26/50			3/16/50	2		50.6	
50-51							41.3	no snow cover
51-52							42.3	no snow cover
52-53	3/2/53			3/3/53	2		43.0	
53-54	11/6/53			1/24/54	7		38.6	
54-55	12/6/54			2/12/55	9		35.6	
55-56							34.6	no snow cover
56-57	1/15/57			1/19/57	5		34.8	
57-58	12/4/57			3/9/58	14		33.7	
58-59	12/11/58	12/14/58	12/14/58	1/17/59	11	1	37.2	
59-60	2/13/60			3/16/60	18		38.6	
60-61	12/12/60			2/8/61	12		31.1	
61-62	1/1/62			3/8/62	16		36.0	
62-63	12/21/62			2/27/63	9		34.3	
63-64	1/12/64			2/29/64	11		37.9	
64-65	1/16/65			2/15/65	11		36.19	

Appendix 4: King and Queen Snow Cover, continued

Year	Date of first snow cover greater than ...		Date of last snow cover greater than ...		Days of snow cover greater than ...		January median temp.	Comments
	1 inch	8 inches	8 inches	1 inch	1 inch	8 inches		
65-66	1/16/66	1/26/66	2/6/66	2/10/66	19	12	31.5	
66-67	12/24/66			2/21/67	23		41.4	
67-68	12/23/67			3/1/68	4		32.7	
68-69	12/7/68			3/9/69	2		34.4	
69-70	1/7/70			1/20/70	7		30.2	
70-71	1/1/71			3/26/71	4		34.0	
71-72	2/2/72			2/20/72	4		39.2	
72-73	1/8/73			1/13/73	6		36.8	
73-74	12/11/73			2/10/74	9		44.8	
74-75	1/20/75			2/4/75	3		40.4	
75-76							34.4	no snow cover
76-77	12/8/76			1/26/77	25		24.4	
77-78	2/2/78			3/4/78	6		31.9	
78-79	2/7/79	2/19/79	2/20/79	2/23/79	17	2	35.7	
79-80	1/5/80	1/6/80	3/2/80	3/4/80	18	2	36.0	
80-81							30.2	no snow cover
81-82	1/13/82			2/28/82	22		29.8	
82-83	12/12/82	2/11/83	2/11/83	2/16/83	13	1	36.2	
83-84	2/5/84			2/6/84	2		31.8	
84-85	1/17/85			1/23/85	6		32.5	
85-86	12/20/85			2/16/86	13		36.4	
86-87	1/22/87	1/26/87	1/29/87	2/19/87	19	4	35.4	
87-88	11/11/87			1/17/88	13		31.9	
88-89	2/18/89			3/7/89	5		41.5	
89-90	12/8/89			12/30/89	23		44.8	
90-91							40.1	no snow cover
91-92							40.2	no snow cover
92-93							41.0	no snow cover
93-94	2/12/94			2/14/94	3		32.8	
94-95	1/28/95			1/30/95	2		39.7	
95-96	12/7/95	1/7/96	1/11/96	2/18/96	24	5	35.2	
96-97	1/9/97			2/8/97	2		37.7	
Median Values								
	1-Jan	**15-Jan**	**4-Feb**	**15-Feb**	**9**	**3**	**36.2**	

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Appendix 5: West Point Snow Cover History

Extension Service
WestVirginiaUniversity

Snow Cover History

Dr. Edward B. Rayburn, Extension Forage Agronomist
Dr. John Lozier, Research Assistant, WVU Extension Service

June 2001

New Kent County, Virginia
West Point Station #9025

Year	Date of first snow cover greater than ...		Date of last snow cover greater than ...		Days of snow cover greater than ...		January median temp.	Comments
	1 inch	8 inches	8 inches	1 inch	1 inch	8 inches		
53-54								no snow cover
54-55	12/6/54			1/19/55	3		35.4	
55-56							35.7	no snow cover
56-57	1/14/57			1/20/57	7		36.3	
57-58	12/4/57			2/15/58	11		34.8	
58-59	12/11/58	12/14/58	12/16/58	1/17/59	14	3	38.7	
59-60	2/13/60			3/16/60	17		39.4	
60-61	12/12/60			2/8/61	15		32.2	
61-62	1/1/62	1/28/62	1/28/62	3/7/62	12	1	37.2	
62-63	12/21/62			2/27/63	6		35.3	
63-64	1/12/64			3/30/64	11		39.4	
64-65	1/16/65			2/15/65	10		37.7	
65-66	1/16/66	1/27/66	2/5/66	2/9/66	19	10	32.9	
66-67	12/24/66			2/20/67	17		41.6	
67-68	12/23/67			3/1/68	6		33.8	
68-69	12/7/68			3/9/69	7		34.6	
69-70	1/6/70			1/20/70	8		31.3	
70-71	1/1/71	3/26/71	3/26/71	3/27/71	7	1	34.4	
71-72	2/17/72			2/19/72	2		40.9	
72-73	1/8/73			1/14/73	7		37.1	
73-74	12/11/73			2/11/74	8		46.3	
74-75	1/20/75			2/4/75	3		41.4	
75-76							34.6	no snow cover
76-77	11/12/76			1/24/77	15		25.3	
77-78	1/9/78			3/3/78	9		32.6	
78-79	2/7/79	2/19/79	2/19/79	2/22/79	16	1	37.6	
79-80	1/5/80	1/5/80	3/2/80	3/4/80	18	3	37.2	
80-81							31.0	no snow cover
81-82	12/25/81	1/15/82	1/15/82	2/27/82	21	1	32.1	
82-83	12/12/82			2/15/83	11		37.3	
83-84							33.0	no snow cover
84-85	1/10/85			1/23/85	8		33.3	
85-86	12/20/85			2/15/86	9		37.3	
86-87	1/22/87	1/26/87	1/26/87	2/19/87	15	1	35.39	

Appendix 5: West Point Snow Cover History (continued)

Year	Date of first snow cover greater than ...		Date of last snow cover greater than ...		Days of snow cover greater than ...		January median temp.	Comments
	1 inch	8 inches	8 inches	1 inch	1 inch	8 inches		
87-88	11/11/87			1/15/88	9		33.1	
88-89	12/9/88			2/25/89	6		42.3	
89-90	12/8/89			12/28/89	21		45.7	
90-91							40.8	no snow cover
91-92							40.9	no snow cover
92-93	1/16/93			2/28/93	4		41.9	
93-94	12/28/93			2/13/94	11		33.2	
94-95	1/29/95			1/29/95	1		41.1	
95-96	1/7/96	1/7/96	2/16/96	2/18/96	21	4	35.6	
96-97							38.7	no snow cover
Median Values								
	1-Jan	**26-Jan**	**5-Feb**	**15-Feb**	**9.5**	**1**	**36.3**	

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