# CALVERT COUNTY, MARYLAND
# 2010 Hazard Mitigation Plan Update

***PREPARED FOR***

**Calvert County Government**
175 Main Street
Prince Frederick, MD 20678

**June 2012**

Submitted by:
**Greenhorne & O'Mara, Inc.**
6110 Frost Place
Laurel, Maryland 20707

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with Assistance from

**Salters Creek Consulting, Inc.**

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# CHAPTER 1 – INTRODUCTION

## Overview

The President signed the Disaster Mitigation Act of 2000 (DMA 2000) into law on October 30, 2000. The act requires local and State governments to prepare and adopt hazard mitigation plans as a condition of receiving Pre-Disaster Mitigation (PDM) grant assistance and Hazard Mitigation Grant Program (HMGP) assistance after November 1, 2004.

The Calvert County Hazard Mitigation Plan is a strategic plan prepared to fulfill the requirements of the Federal Disaster Mitigation Act of 2000 (DMA 2000), as administered by the Maryland Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA) Region III. This plan complies with all the eligibility requirements for FEMA grant assistance to participating localities, including the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA), and the Pre-Disaster Mitigation (PDM) grant program. This plan covers a multi-jurisdictional planning area in southern Maryland, including Calvert County, the Town of North Beach and the Town of Chesapeake Beach.

Calvert County was awarded HMGP funding in 2003 to assist with the development of a DMA 2000 compliant Hazard Mitigation Plan. During late 2003 and most of 2004, the County followed the required planning process and adopted a plan in April, 2005. Chesapeake Beach and North Beach also participated in the planning process and adopted the plan in 2005.

In 2010, the County again received funds from FEMA to assist with an update to the original plan. The Planning Team reconvened and met over the course of several months in 2010 and 2011 to update the plan. This updated plan is the result of that effort and represents the mitigation priorities for Calvert County, the Town of Chesapeake Beach and the Town of North Beach. Additionally, Calvert County adopted a Flood Mitigation Plan, funded through a Flood Mitigation Assistance (FMA) grant, in July 2011. The Flood Mitigation Plan provides a detailed analysis of the flood hazard in Calvert County. During the review of the Hazard Mitigation Plan by FEMA, it was recommended that the Flood Mitigation Plan be included as part of the plan. The Flood Mitigation Plan has been included as Appendix B.

## Authority

1. Section 409 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288, as amended), Title 44 CFR, as amended by Section 102 of the Disaster Mitigation Act of 2000, provided the framework for state and local governments to evaluate and mitigate all hazards as a condition for receiving Federal disaster assistance. A major requirement of the law is the development of a local hazard mitigation plan.
2. Calvert County Emergency Operations Plan.

## Purpose

Hazard Mitigation is any action taken to permanently reduce or eliminate long-term risks to people and property from the effects of hazards. Natural hazards come in many forms: tornadoes, floods, hurricanes, severe storms, winter freezes, droughts, landslides, or dam failures resulting from natural disaster crises. Communities can take steps to prepare and implement mitigation techniques for almost any type of hazard that may threaten its citizens, businesses, infrastructure, and institutions.

This plan establishes an ongoing hazard mitigation planning program by identifying and assessing potential natural hazards that may pose a threat to life and property, evaluating local mitigation measures that should be undertaken and outlining procedures for monitoring the implementation of mitigation strategies. The plan provides guidance to county officials and staff regarding local mitigation activities over the next five-year planning cycle. It encourages activities that are most effective and appropriate for mitigating the effects of all identified natural hazards.

FEMA has implemented hazard mitigation planning requirements through federal regulations (44 CFR 201). In Maryland, MEMA works with FEMA to implement disaster mitigation efforts. FEMA administers several programs that provide hazard mitigation funding. Typically grants allow a cost-share of 75 to 90 percent federal funding for eligible projects. Such programs include the HMGP, PDM, FMA, Repetitive Flood Claims (RFC), and Severe Repetitive Loss (SRL).

- Hazard Mitigation Grant Program (HMGP) – HMGP provides funds in accordance with priorities identified in hazard mitigation plans to implement mitigation measures during disaster recovery. State and local governments, certain private non-profit organizations, and tribes are eligible sub-applicants.
- Pre-Disaster Mitigation (PDM) – PDM provides funds for hazard mitigation planning and implementation prior to a disaster event. State-level agencies, tribes, local government, and public colleges are eligible sub-applicants.
- Flood Mitigation Assistance (FMA) – FMA implements cost-effective measures to reduce or eliminate long-term risk of flood damage to structures insured through the National Flood Insurance Program (NFIP). State-level agencies, tribes, and local government are eligible sub-applicants.
- Repetitive Flood Claims (RFC) – RFC intends to reduce/eliminate long-term risk to structures with one or more NFIP claims. State-level agencies, tribes, and local governments that cannot meet FMA requirements for cost-share or management capacity are eligible sub-applicants. Project grants are available for acquisition, structure demolition, or structure relocation of insured structures, with the property deed restricted for open space uses in perpetuity.
- Severe Repetitive Loss (SRL) – SRL Program is intended to reduce/eliminate risk to severe repetitive flood loss properties insured under the NFIP. The SRL program provides funding to minimize the long term risk of flood damage to residential structures insured under the NFIP. The properties eligible for this program are those that have had four or more flood insurance claims payments that have each exceeded $5,000, and the cumulative amount of such claims payments exceed $20,000, or two or more flood insurance claims payments (building payments) for which the cumulative amount of the building portion of the claim exceeds the market value for the building.

## Consistency with State and Federal Mitigation Policies

The goals, objectives and policies of this plan intend to implement the National and State directives for mitigation of natural hazards through local strategies intended to:

- Substantially increase public awareness of natural hazard risk and the measures available to create safer, more disaster-resistant communities; and
- Significantly reduce the risk of loss of life, injuries, economic costs and destruction of natural and cultural resources that result from natural hazards.

FEMA has developed 10 fundamental principles for the Nation's mitigation strategies which likewise underlie the strategies of this plan:

1. Risk reduction measures ensure long-term economic success for the community as a whole rather than short-term benefit for special interests.
2. Risk reduction measures for one natural hazard must be compatible with risk reduction measures for other natural hazards.
3. Risk reduction measures must be evaluated to achieve the best mix for a given location.
4. Risk reduction measures for natural hazards must be compatible with risk reduction measures for technological hazards and vice versa.
5. All mitigation is local.
6. Disaster costs and the impacts of natural hazards can be reduced by emphasizing pro-active mitigation before emergency response; both pre-disaster (preventive) and post-disaster (corrective) mitigation is needed.
7. Hazard identification and risk assessment are the cornerstones of mitigation.
8. Building new Federal-State-local partnerships and public-private partnerships is the most effective means of implementing measures to reduce the impacts of natural hazards.
9. Those who knowingly choose to assume greater risk must accept responsibility for that choice.
10. Risk reduction measures for natural hazards must be compatible with the protection of natural and cultural resources.

## Organization of the Plan

The next few chapters comprise the Hazard Mitigation Plan.

Chapter 1 introduces the authorities and purposes for **hazard mitigation planning**.

Chapter 2 comprises the **county profile** and identifies the unique characteristics of Calvert County and the participating jurisdictions, along with a brief socio-economic and demographic profile.

Chapter 3 outlines the **planning process** that was undertaken in the development of the Calvert County Hazard Mitigation Plan. It establishes the formation of the Planning Team, the public participation strategy, and the process for interagency and intergovernmental coordination.

Chapter 4 encompasses the natural **hazard identification and risk assessment**.

Chapter 5 details the **vulnerabilities assessment**.

Chapter 6 assesses the **mitigation capabilities** of the county and the incorporated communities.

Chapter 7 includes the **mitigation strategy** which lists the mitigation measures, tasks, lead agencies or departments, and identifies potential funding sources.

Chapter 8 outlines the **plan maintenance** procedures and details how Calvert County and the incorporated communities will maintain the mitigation plan to keep the data current and update the progress on the mitigation strategy.

The appendices include information from the Calvert County Hazard Mitigation Planning Team (Planning Team) meetings, questionnaires, and supplemental reference materials.

## 2010 Updates to Chapter 1

As part of the 2010 update to the plan, this section was revised to include information about the update in the “Overview”, to delete information regarding manmade hazards in the “Purpose” and to append information regarding the SRL Program of the NFIP.

# CHAPTER 2 – COUNTY PROFILE

## Location

Calvert County is located 30 miles southeast of Washington, D.C. in Southern Maryland (Figure 1). Calvert County is a peninsula bounded on the south and east by the Chesapeake Bay and on the west by the Patuxent River. The Thomas Johnson Bridge at the south-most-point connects Solomons Island, in Calvert County with St. Mary's County, Maryland, and the Patuxent River Bridge connects Calvert County with Charles County, Maryland. The county contains approximately 219 square miles and is only 35 miles long north to south, and varies in width between 5 and 9 miles.

**Figure 1: Southern Maryland**

There are two incorporated towns, both located on the Chesapeake Bay in northern Calvert County, Chesapeake Beach, incorporated in 1886 and North Beach, incorporated in 1910. The county seat is Prince Frederick, located in the middle of the county. The 2010 Calvert County Comprehensive Plan identifies seven “town centers” including (from north to south):

- Dunkirk,
- Owings,
- Huntingtown,
- Prince Frederick,
- St. Leonard,
- Lusby, and
- Solomons.

## Physical Features

The topography of Calvert County is variable and rugged. An upland plain runs from the northwest to the southwest. On the Chesapeake Bay side, the upland ends in high cliffs of clay, gravel and sand, which extend from the shoreline to maximum heights of 125 to 135 feet. On the west, the upland areas slope toward the Patuxent River where rich farmland is found. The water generally drains from the central elevation towards the Bay and River on either side of the county.

## Watersheds

Calvert County intersects two of the State's primary watersheds (Figure 2): the Lower Western Shore (shown in yellow) and the Patuxent Watershed (shown in purple). The two watersheds are separated along the central elevation in the county with the Lower Western Shore on the eastern most side of the county draining towards the Chesapeake Bay and the Patuxent Watershed encompassing the western two-thirds of the county and draining towards the Patuxent River.

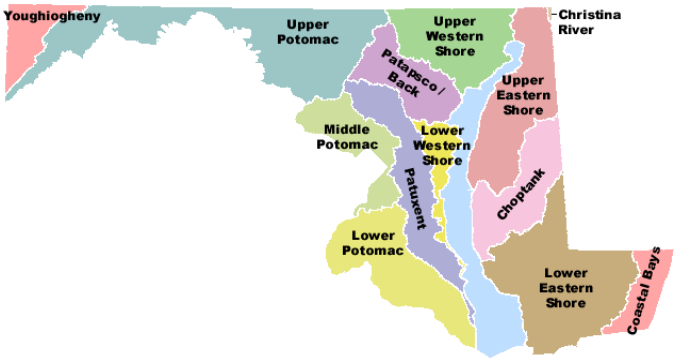


**Figure 2: Maryland Watersheds**

## Population

In 2010 Maryland's population was 5,773,552, according to the federal census conducted every 10 years by the U.S. Census Bureau (See Table 1). From 2000 to 2010, Maryland's population grew 9%, a gain of 477,066 persons; Calvert County had a population increase of 19%, which ranked it the 4th fastest growing county in the State. The population for the Town of Chesapeake Beach increased 45% and the population for North Beach increased by 5% during the same period.

As of the 2010 census, Calvert County's population was 88,737 people, 30,873 households, and 23,732 families residing in the county. The population density was 412.4 people per square mile.

In the county, the age distribution of the population is spread out with 28.77% under the age of 19, 5.45% from 20 to 24, 24.05% from 25 to 44, 30.82% from 45 to 64, and 10.91% who are 65 years of age or older. The median age of the population in Calvert County is 40.1 years.

**Table 1: Population**

| | 2000 Census | 2010 Census | 2020 Projected | 2030 Projected |
|---|---|---|---|---|
| State of Maryland | 5,296,486 | 5,773,552 | 6,576,300 | 6,664,250 |
| Calvert County | 74,563 | 88,737 | 99,350 | 103,950 |
| Town of Chesapeake Beach | 3,180 | 5753 | - | - |
| Town of North Beach | 1,880 | 1978 | - | - |

*Source: U.S. Bureau of the Census; Maryland Department of Planning*

## Housing

According to the 2010 Census, there are 33,780 housing units in Calvert County. There are 30,873 households out of which 35.9% have children under the age of 18 living with them, 60.6% are married couples living together, 11.3% have a female householder with no husband present, and 23.1% are non-families. In addition, 18.1% of all households are made up of individuals and 4.9% have someone living alone who is 65 years of age

or older. The average household size is 2.85 people and the average family size is 3.23 people.

## Income and Poverty

The median income for a household in the county is $91,088 and the average household income is $103,384.The per capita income for the county is $35,434. In addition, 5.4% of the population is living below the poverty line. Out of the total people living in poverty in Calvert County, 7.5% are under the age of 17.

*http://www.ers.usda.gov/Data/PovertyRates/PovListpct.asp?st=MD&longname=Maryland*

## Economy

During the 1800's, Calvert County's main industry was farming tobacco. In 1867, Captain Isaac Solomon established a commercial fishery in Solomons Island. At that time, boat building, a cannery and a fishery all contributed to the county's economy. Today, Calvert County has more than 1,850 businesses. Major employers include: Calvert County Board of Education, Calvert County Government, Calvert Memorial Hospital, Calvert Cliffs Nuclear Power Plant/CENG and Wal-Mart (see Table 2).

**Table 2: Calvert County Major Employers**

| Major Employers | Approximate Number of Employees |
|---|---|
| Calvert County Board of Education | 2,236 |
| Calvert County Government | 1,301 |
| Calvert Memorial Hospital | 1,146 |
| Calvert Cliffs Nuclear Power Plant/CENG | 892 |
| Wal-Mart | 460 |
| ARC of Southern Maryland | 425 |
| Giant Food | 385 |
| Navy Recreation Center | 292 |
| Safeway | 290 |
| Asbury Solomons Island | 229 |
| Chesapeake Beach Resort & Spa | 215 |
| McDonalds | 200 |
| All American Ambulance & Transport | 200 |
| Calvert County Nursing Center | 200 |
| Recorded Books | 179 |
| Food Lion | 175 |
| Fantasy World Amusements | 165 |
| Stoney's Solomons Pier Restaurant | 165 |
| Solomons Nursing Center | 151 |

| Major Employers | Approximate Number of Employees |
|---|---|
| Chesapeake Biological Laboratory | 150 |
| Dyncorp International | 145 |
| Edward B. Howlin | 128 |
| DirectMail.com | 125 |
| College of Southern Maryland | 121 |
| Calvert Internal Medicine Group | 112 |
| Dominion Cove Point LNG | 109 |
| The Gott Company | 103 |
| Holiday Inn Solomons | 100 |

http://www.ecalvert.com/content/business/thebasics/labor/majoremployers.asp

## Climate

Calvert County's climate is generally mild. There are four distinct seasons with spring and fall being particularly pleasant with low humidity and mild temperatures. The average winter temperature is 36.4 degrees F and the summers can be hazy, hot, and humid with an average summer temperature of 74.4 degrees F. Afternoon thunderstorms are also a common occurrence in the summer months. The average annual precipitation is 43.1 inches and the average yearly snowfall in Calvert County is 19.4 inches. (Source: Maryland State Office of Climatology (based on 30 year averages)).

## Transportation

Calvert County is accessible via major transportation networks, including: I-95, US 301, MD Routes 2, 4, and 5, and Route 235. The Port of Baltimore is also nearby and facilitates regional imports and exports.

MD Route 2 connects with US 50/301, and MD Route 4 connects with US 301 and the Capital Beltway (I-495). The Thomas Johnson Bridge over the Patuxent River connects MD Routes 2/4 in the southern part of the county with MD Routes 5/235 in St. Mary's County.

Calvert County is served by the Port of Baltimore, with a 50 foot channel through the Chesapeake Bay.

## Utilities

Electricity is provided by Baltimore Gas and Electric (BG&E) and Southern Maryland Electric Cooperative, Inc. (SMECO). Washington Gas provides natural gas in the county.

The majority of county residents are served by private water systems, individual wells and traditional septic systems. Public water and sewerage service is provided to pocket communities and town centers. The county's wastewater system is comprised of eight wastewater treatment plants, 39 wastewater pump stations, 32 miles of force main and

34 miles of gravity sewer outfalls. The water system is comprised of 20 municipal water systems, 77 miles of water main, and 10 elevated storage tanks.

The Calvert Cliffs Nuclear Power Plant is run by CENG and is located near Lusby, along the western shore of the Chesapeake Bay.

The Cove Point LNG plant is run by Dominion and is also located near Lusby along the western shore of the Chesapeake Bay.

Verizon Communications is the local telecommunications carrier. In addition, long-distance telecommunications services are provided by AT&T, Comcast, MCI WorldCom, Sprint, and over 250 additional carriers and resellers of WATS and MTS. Cable internet and ISDN digital switching and fiber are also available in the county.

## Analysis of Development Trends

According to the Calvert County Comprehensive Plan (2010), "the number of households in Calvert County increased from 5,540 in 1970 to 25,447 in 2000. During most of that 30-year period, Calvert County was the fastest growing county in the State."

In Calvert County, the Town Centers are the primary areas slated for development. The Town Centers are: the Towns of North Beach and Chesapeake Beach, Owings, Dunkirk, Huntingtown, Prince Frederick, St. Leonard, Lusby, and Solomons Island. To promote this development pattern, the county has developed Master Plans for each of the Town Centers and rezoned areas within one mile of each town to permit higher density with the purchase of Transferable Development Rights. In addition, the county has dedicated itself to providing adequate roads, water, wastewater systems, public transportation, and high-quality internet communication systems, together with public amenities such as parks, town squares, trails, sidewalks, bikeways, and indoor recreational and cultural facilities. The county's goal of creating a more compact pattern of development is aimed at reducing dependence upon automobiles and enabling people to live within convenient proximity to stores, offices, and services.

Residential development in Calvert County was limited to farms and the small towns of North Beach, Chesapeake Beach, Prince Frederick, and Solomons until the early 20th century. During the late 1960s and early 1970s, most newcomers tended to settle in small-lot communities along the Chesapeake Bay, most of which had originally been designed for seasonal use only during the summer and prime fishing months. These small settlements developed prior to the adoption of zoning in 1967. In the 1970s, large-lot residential subdivisions began to replace farms and became the dominant residential land use pattern. By 2002, 42% of all households were located in small-lot communities created prior to the adoption of zoning in 1967, 43% lived in subdivisions in the RUR District, and 15% lived in town centers.

One of the land use challenges in Calvert County is tied to the small-lot communities, which are zoned Residential District. The communities developed before many of the health and safety regulations were adopted and are now experiencing problems with sewage disposal, stormwater management, and road maintenance. According to the 2010 Comprehensive Land Use Plan, in 2002 there were 4,100 undeveloped lots that were exempt from most current regulations and accounted for nearly one-quarter of the potential future households in the county.

## 2010 Updates to Chapter 2

As part of the 2010 update to the plan, this chapter was revised to include data from the 2010 U.S. Census, where available.

# CHAPTER 3 – PLANNING PROCESS

Calvert County and the Towns of Chesapeake Beach and North Beach followed a well-established planning process to develop this update to the Mitigation Plan. A kickoff meeting was held by conference call on January 18, 2011. The call was led by Stephen E. Smith, Senior Mitigation Planner, Greenhorne & O'Mara (G&O), the firm contracted by the County to facilitate the plan update. Also included on the call were John Robert Fenwick, Division Chief, Calvert County Emergency Management, and Carl F. Brown, Planner, Calvert County Emergency Management, who were responsible for local logistics, public communications, recruiting the Planning Team and providing data for analysis (see Table 3).

**Table 3: Calvert County Planning Team Members**

| Name | Representing |
|---|---|
| Carolyn McHugh | Calvert Chamber of Commerce |
| Rick Woods | Calvert Cliffs Nuclear Power Plant/CENG |
| Bobby Fenwick | Calvert County Emergency Management |
| Carl F. Brown | Calvert County Emergency Management |
| Walter McKain | Calvert County General Services |
| Erick Pate | Calvert County Information Technology (GIS) |
| Greg Bowen | Calvert County Planning & Zoning |
| John Swartz | Calvert County Planning & Zoning |
| Jacqueline Vaughan | Calvert County Public Safety |
| Ron Clark | Calvert County Roads |
| Bonnie Burris | Calvert Housing Authority |
| Debora Huddleston | Chesapeake Ranch Estates |
| Rich Hannigan | Dominion Cove Point LNG |
| James Parent | Town of Chesapeake Beach |
| Joanne Hunt | Town of North Beach |
| Sandy Simmons | Calvert County Emergency Management |

The Planning Team reconvened in March, 2011 and held three different meetings during the period of March, 2011 to June, 2011. Documentation of these meetings in the form of sign-in sheets, agendas, and minutes are provided in Appendix A.

The Planning Team was actively involved in identifying hazards within the county, reviewing the county's vulnerabilities to natural hazards, and recommending mitigation measures to reduce and prevent potential damage from these hazards. The Planning Team then worked together to select the most appropriate and feasible mitigation measures.

At the first Planning Team Meeting held on March 15, 2011, G&O presented an overview of the mitigation planning process and the Planning Team reviewed the identified hazards, discussed the history and profile of each hazard and identified areas vulnerable to the hazards. The Planning Team's detailed review and discussion of the list of identified hazards (shown in Chapter 4, Table 6) indicated that the list meets the team's needs and did not need any additions, deletions or corrections for the updated plan. During the first Public meeting held on March 16, 2011, questionnaires were provided to garner comments about past hazard events and suggestions on potential mitigation measures. The questionnaire is included in Appendix A.

The Planning Team reviewed the Risk Analysis and Vulnerabilities Assessment at the second Planning Team meeting held on May 3, 2011. At this meeting, the Planning Team commented on the results of the updated assessment and reviewed the existing goals and objectives to ensure that they address current vulnerabilities.

A third meeting was held with the Planning Team on May 4, 2011 to review and update the mitigation measures and prioritize them. At this meeting, the Planning Team worked diligently to link the updated goals and objectives with a set of mitigation actions that help accomplish the goals. Each existing action was reviewed and discussed to determine if it should be retained. The group brainstormed a list of new mitigation actions and then evaluated each to determine whether it was consistent with local social, technical, administrative, political, legal, economic and environmental conditions. Upon arriving at a final set of mitigation actions, the team prioritized the list, discussed costs and benefits, and determined responsible departments.

## Public Involvement

In compliance with DMA 2000 requirements, public participation was encouraged throughout the mitigation planning process and the 2010 update. The Planning Team solicited public input through meetings, the local news media, and the county's internet website.

Two public information meetings were held in the County during the planning process. The first meeting was held on March 16, 2011. During this meeting, the planning process was presented as well as information regarding the hazards and risks that are present in the participating jurisdictions. A 2$^{nd}$ public meeting was held on September 27, 2011 to present the draft plan to the citizens.

The draft plan was displayed on the county's website for the public to view and to garner public input and comments. In addition, the plan was made available to the public in the towns of Chesapeake Beach and North Beach through their administrative or Public Works Departments. Advertisements were placed in the *Calvert County Recorder* and the *Calvert Independent* newspapers to notify residents and business owners of the mitigation plan prior to adoption by the Board of County Commissions and respective town governments.

## Interagency and Intergovernmental Coordination

In addition to the Planning Team members listed in Table 3, various local, state and federal agencies were contacted to provide data, input and cooperation for the Calvert County Hazard Mitigation Plan. These agencies and the main reason for contact are shown in Table 4.

**Table 4: Interagency Coordination**

| Agency | How Contacted | Reason for Contact |
|---|---|---|
| Maryland Department of the Environment | Telephone and e-mail | Repetitive loss information |
| Maryland Department of Natural Resources | Telephone and e-mail | Shore erosion data |
| Maryland Geological Survey | Telephone and e-mail | Shore erosion data |
| Maryland Emergency Management Agency | E-mail and Internet Website | Risk assessment data and disaster history |
| Maryland Department of Planning | E-mail and Internet Website | Demographics and MD Property View Data |

MEMA serves as the State review agency and initiates the State Clearinghouse process which routes the final plan to all pertinent State agencies for review and comment.

## Participating Jurisdictions

The Towns of North Beach and Chesapeake Beach participated by direct representation on the Planning Team. In addition, they participated through the following means:

- Responding to questionnaires;
- Attending committee meetings;
- Reviewing draft plan sections;
- Offering comment on the draft plan; and,
- Adopting final plan through formal resolution.

## Integration with existing plans

The Calvert County Hazard Mitigation Plan will be incorporated as an Annex to the existing Calvert County Emergency Operations Plan, administered through the County Emergency Management Agency. The Calvert County Comprehensive Plan and Capital Improvements Plan have been updated and the policies of this mitigation plan have been incorporated into these planning documents. The Calvert County Flood Mitigation Plan also addresses mitigation actions and strategies necessary to reduce future losses from flooding. Both the Towns of North Beach and Chesapeake Beach will be incorporating mitigation goals and strategies from the mitigation plan into future amendments of their planning documents.

## 2010 Updates to Chapter 3

As part of the 2010 update to this plan, this section was revised to include the new members of the Planning Team and to include details of how the Planning Team accomplished its goals during the 2011 meetings. Updates were also made to the “Public Involvement” section to indicate how the public was notified of Planning Team actions. Appendix A was also updated to include materials generated during the update.

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# CHAPTER 4 – RISK ASSESSMENT

## Overview

The Risk Assessment identifies all of the natural hazards that can affect Calvert County. It provides information on the history and extent of the hazards and evaluates the possible effects, vulnerable populations and assets (buildings, infrastructure, critical facilities), and estimates the potential losses that might occur. The four major steps in the Risk Assessment include Hazard Identification, Hazard Profiles, Vulnerability Assessment, and Loss Estimation.

## Hazard Identification

The Planning Team began by investigating various types of natural hazards faced by the County over the past several decades. The hazard identification process includes a history and an examination of various hazards and their occurrences. Information regarding past hazards was based on history and research from historical documents and newspapers; county plans and reports; conversations with county residents and public officials, and internet websites. Data and maps that were available online included sources such as the United States Geological Survey (USGS), Sheldus, and the National Weather Service (NWS).

Table 5 shows the 10 Federal Declarations of Emergency that have included Calvert County. In addition, there have been many more State and local disasters that have occurred within the county, which will be discussed further for each hazard.

**Table 5: Federal Disaster Declaration History**

| Event | Declaration Date | Individual Assistance(IA)/Public Assistance(PA) | Disaster Number |
|---|---|---|---|
| Tropical Storm Agnes | 1972-Jun-23 | IA | 341 |
| Heavy rains and flooding | 1975-Oct-04 | IA/PA | 489 |
| Severe storms, tornadoes, and flooding | 1979-Sep-14 | IA | 601 |
| Severe winter storm | 1994-Mar-16 | PA | 1016 |
| Blizzard of 96 | 1996-Jan-11 | PA | 1081 |
| Hurricane Floyd | 1999-Sep-24 | IA/PA | 1303 |
| Severe winter storm | 2000-Apr-10 | PA | 1324 |
| Tornado | 2002-Apr-28 | IA/PA | 1409 |
| Hurricane Isabel | 2003-Sep-19 | IA/PA | 1492 |
| Severe Winter Storms/Snowstorms | 2010-May-06 | PA | 1910 |

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

The Planning Team reviewed the list of potential hazards and identified those that have been known to occur in Calvert County and those that can possibly occur anywhere. The list of hazards was obtained from the Maryland Hazard Analysis completed by MEMA in June 2005. The State Analysis ranks tornadoes; tidal/coastal flooding and extreme cold as medium-high hazards; extreme summer heat, hurricane, thunderstorm,

as medium hazards; and winter weather, drought, flash flooding, and soil movement as medium-low hazards for Calvert County.

Table 6 shows the natural hazards which have been documented in Calvert County and have been assessed as risks for the purpose of this study.

**Table 6: Hazard Identification**

| Hazard | How Identified | Why Identified |
|---|---|---|
| Coastal/Shoreline Erosion | • Review of past disaster declarations<br>• Input from the Maryland Shoreline Taskforce | • Severity of past events and projection of future events<br>• Presence of the Calvert Cliffs |
| Dam Failure | • Input from Maryland Emergency Management Agency<br>• Local knowledge/public input | • National Inventory of Dams lists 13 dams within Calvert County |
| Drought | • Review of past disaster declarations<br>• Review of Governor's Drought Task Force findings | • Severity and frequency of past events<br>• Number of county residents on private wells |
| Earthquake | • Input from the Maryland Geological Survey | • Proximity of past events |
| Extreme Summer Heat | • Review of NWS records<br>• Local knowledge/public input | • Severity of past events |
| Flooding | • Review of past disaster declarations<br>• Review of Flood Insurance Rate Mapping<br>• Identification of NFIP repetitive loss properties<br>• Analysis of post-disaster/risk assessment reports<br>• Local knowledge/public input | • Severity and frequency of past events<br>• Presence of the Chesapeake Bay, Patuxent River and tributary streams |
| Hurricane/ Tropical Storm | • Review of past disaster declarations<br>• Analysis of post-disaster/risk assessment reports<br>• Local knowledge/public input | • Severity of the flood-related damages caused by Hurricane Isabel (2003) |
| Landslide | • Input from the Maryland Geological Survey<br>• Input from the Maryland Department of Transportation | • Topography within the county<br>• Known landslide potential of various locations within the county |
| Land Subsidence | • Input from the Maryland Geological Survey<br>• Input from Department of Natural Resources | • Presence of the Chesapeake Bay and documented sea level rise incidents tied to land subsidence |
| Severe Storm (thunderstorm, hailstorm, and winter storm | • Review of past disaster declarations<br>• Input from the National Weather Service<br>• Local knowledge/public input | • Severity and frequency of past events |
| Tornado | • Review of past disaster declarations<br>• Input from the National Weather Service | • Severity and frequency of past events |
| Tsunami | • Review of NOAA Tsunami Mitigation Plan | • Presence of Chesapeake Bay and possibility of storm surge damages |
| Wildfires | • Review of past disaster declarations<br>• Input from the Maryland Department of Natural Resources | • Frequency of past events<br>• Presence of large forested tracts within the county |

## Hazard Profiles

After the initial identification of natural hazards, the Planning Team developed profiles for each of the hazards. The profiles include a description of the hazard, history of the past hazard events, and when possible a determination of the frequency or probability of future events, their severity, and factors that may affect their severity. Each hazard type has unique characteristics that can impact the county.

### *Coastal/Shoreline Erosion*

Overview

Erosion and accretion are long term, dynamic processes that occur along shorelines. Major erosion/accretion events are usually associated with coastal storms because floodwater forces have the ability to cause significant acts of erosion/accretion in a short time period. Erosion is considered a serious hazard in coastal areas because it can threaten coastal development by eroding beaches and shorelines. In general, shore erosion poses a significant threat to property owners, the public, and natural resources; both terrestrial and aquatic.

History

The western shore of the Chesapeake Bay in Calvert County varies from steep, eroding cliffs to stable slopes. Cliffs are continually eroded by wave action, landslides, groundwater seepage, freeze/thaw action and weathering.

All shorelines in the county are subject to the effects of erosion. The most severe impacts occur along those shorelines with the longest fetch or exposed distance over water in front of the shore. Although erosion is a natural process, it can create significant problems for property owners, businesses, and the public, especially when inappropriate planning and design activities either increase natural erosion rates or compound the impact of natural erosion processes. The Maryland Geological Survey (MGS) began to quantify the problem in 1914, documenting major reductions of various islands throughout the state.

A large percentage of Calvert County's shorelines incur erosion accelerated by high winds and high tides. The greatest numbers of incidences occur during the fall and winter months. A small number of damaging wind events coupled with abnormally high tides, causing shoreline erosion occurs each year. The State of Maryland Shore Erosion Task Force Final Report (2000) estimates that 31% of the State's 4,360 miles of tidal shoreline currently experience some degree of erosion and approximately 41% of Calvert County's 143 miles of shoreline currently experience some degree of erosion. 45 miles experience less than 2 feet of erosion, 9 miles experience between 2 and 4 feet per year and 4 miles experience greater than 4 feet of erosion per year.

In 2010, state, federal and county agencies formed a steering committee to study and develop recommendations to address the impact of shoreline erosion on houses located near the eroding cliffs in Calvert County. The Committee developed a preliminary framework for addressing these issues and presented their findings in the *Chesapeake Bay Cliff Erosion in Calvert County Draft Steering Committee Report.* The report documents that the cliffs have been naturally eroding for hundreds of years. The presence of the federally threatened and state endangered Puritan Tiger Beetle living at various locations along the shoreline and the potentially adverse impact that cliff and shoreline stabilization could have on its habitat, increases the difficulty of finding feasible mitigation methods.

Property owners in Chesapeake Ranch Estates have anecdotally reported an erosion rate of approximately two feet per year. This rate is far from constant, as the bluffs can often give way without warning. In 1996, a cliff suddenly collapsed and caused the death of a young girl on the beach below. One property owner, who bought a house in 1991, noted that his house was 60 feet from the cliff's edge. Without armor, the house is now 20 feet from the edge, an estimated erosion rate of two feet per year. Another property owner has lost 40 feet of shoreline since 1996, or 2.8 feet per year. A third property owner has experienced four feet of erosion in just one year.

Hurricane Floyd, preceded by a prolonged drought in 1999, eroded approximately 5 to 10 feet of a cliff edge overlooking the Chesapeake Bay, and exposed the foundation of two structures, forcing the county to condemn them. Additional structures also lost a great part of the back yards, but still had plenty of setback available to continue safe occupancy of the structures.

Tropical Storm Isabel in 2003 also resulted in a large amount of erosion, exposing foundations and undermining public roads along the Randall Cliffs area.

Heavy rains at the end of September 2010 caused additional sloughing at another property in which the house was already only eight feet from the cliff.

Probability

Based on historical trends, the probability of shoreline erosion continuing in Calvert County is high. In addition, as the shoreline continues to erode, more structures will continue to lose existing yards, which protect the structure from possible landslides or eventual collapse if soil under the foundation erodes away.

### *Dam Failure*

Overview

Dam failure refers to a collapse, overtopping, breaching, or any other related condition that causes an uncontrolled release of water and downstream flooding. Approximately one-third of all dam failures worldwide are caused by overtopping due to inadequate spillway capacity, another third are caused by seepage, and the rest result from improper design or construction, or hazards such as landslides and earthquakes.

The severity of a dam failure depends on its storage capacity and the types of land uses downstream. The hazard potential is the possible adverse consequences resulting from the release of water and other stored contents due to failure or improper operation of the dam. Once a dam is constructed, the downstream hydrologic regime may change, altering the frequency and severity of flood events. The change in hydrologic regime can encourage encroachment upon a reduced 100-year floodplain.

In recent years, dam failures in the United States have prompted renewed public and government concern and action. Public Law 92-367, the National Dam Inspection Act, resulted in the inventorying of dams in the United States and the inspection of non-Federal dams nationally.

Common practice among Federal and State dam safety offices is to classify a dam according to the potential impact a dam failure (breach) or mis-operation (unscheduled release) would have on upstream and/or downstream areas or at locations remote from the dam. The hazard potential classification system categorizes dams based on the probable loss of human life and the impact on economic, environmental, and lifeline

interests. Improbable loss of life exists where persons are only temporarily in the potential inundation area. The Dam Hazard Classification is shown in Table 7.

**Table 7: Dam Hazard Classification**

| Category | Loss of Life | Property Damage |
|---|---|---|
| Low | Unlikely loss of life | Minor increases to existing flood levels at roads and buildings. |
| Significant | Possible loss of life | Significant increased flood risks to roads and buildings with no more than 2 houses or 6 lives in jeopardy. |
| High | Probable loss of life | Major increases in existing flood levels at houses, buildings, major interstates and state roads with more than 6 lives in jeopardy. |

The National Inventory of Dams lists 13 dams within Calvert County. Dams less than 25 feet in height are generally exempt from the Dams and Reservoirs Safety Act because, in most cases, their failure would not pose a serious threat to life, safety, or property.

**Table 8: Calvert County Dams**

| Dam Name | River | Purpose | Year Complete | Height | Storage |
|---|---|---|---|---|---|
| Gordon Farm Pond | Fishing Creek | Recreation | 1969 | 28 (ft) | 154 (ac-ft) |
| Bowens Farm Pond | Cypress Swamp | Wildlife, fire/stock | 1970 | 20 (ft) | 91 (ac-ft) |
| Shores of Calvert Lower Dam | Patuxent River | Recreation | 1972 | 15 (ft) | 126 (ac-ft) |
| Lake Lariat Dam | Mill Creek | Recreation | 1965 | 46 (ft) | 2614 (ac-ft) |
| Dominion Cove Point LNG Main Dam | Wilbur Creek | Recreation, Tailings | 1974 | 74 (ft) | 830 (ac-ft) |
| Dominion Cover PointLNG Secondary Dam | Wilbur Creek | Tailings | 1974 | 34 (ft) | 42(ac-ft) |
| Ferry Landing Woods Pond | Patuxent River | Recreation | 1981 | 22 (ft) | 150 (ac-ft) |
| Queensberry Drive SWM | Hunting Creek | Flood Control | 2001 | 19 (ft) | 30 (ac-ft) |
| Calvert Gateway | Hall Creek | Flood Control | 2000 | 19.7 (ft) | 4.05 (ac-ft) |
| Starkey Pond | Morsell Creek | Recreation | 1950 | 11 (ft) | 150 (ac-ft) |
| Victoria Station Lake Community | Graham Creek | Recreation | 1986 | 23 (ft) | 920 (ac-ft) |
| Shores of Upper Calvert Dam | Patuxent River | Recreation | 1972 | 25 (ft) | 0 (ac-ft) |
| Prince Frederick WWTP Pond 2 | Parker Creek | Other | 2002 | 45 (ft) | 100 (ac-ft) |

(ft)= feet; (ac-feet) = acrefeet

History

There is no history of dam failure in Calvert County.

Probability

Based on past history there is a low probability of dam failure in Calvert County; however, contributing factors such as the age of the infrastructure, seasonal weather patterns, and developmental patterns all make the potential for dam failure a possibility in the future.

## *Drought*

Overview

Drought is a condition of climatic dryness that is severe enough to reduce soil moisture and water and snow levels below the minimum necessary for sustaining plant, animal, and economic systems. Drought is a complex physical and social process of widespread significance. It is not usually a Statewide phenomenon, with differing conditions in the State often making drought a regional issue. Despite all of the problems that droughts have caused, drought has proven to be difficult to define and there is no universally accepted definition. Droughts, unlike floods, are not distinct events with well-defined starting points and ending points. The impacts of droughts vary by affected sector, thus often making definitions of drought specific to particular affected groups.

The most commonly used drought definitions are based on meteorological, agricultural, hydrological and socioeconomic effects.

I. **Meteorological** drought is often defined by a period of substantially diminished precipitation duration and/or intensity. The commonly used definition of meteorological drought is an interval of time, generally on the order of months or years, during which the actual moisture supply at a given place consistently falls below the climatically appropriate moisture supply.

II. **Agricultural** drought occurs when there is inadequate soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought usually occurs after or during meteorological drought but before hydrological drought and can also affect livestock and other dry-land agricultural operations.

III. **Hydrological** drought refers to deficiencies in surface and subsurface water supplies. It is measured as streamflow, snowpack, and as lake, reservoir and groundwater levels. There is usually a delay between lack of rain or snow and less measurable water in streams, lakes and reservoirs. Therefore, hydrological measurements tend to lag other drought indicators.

IV. **Socioeconomic** drought occurs when physical water shortages start to affect the health, well-being, and quality of life of residents, or when the drought starts to affect the supply and demand of an economic product.

Droughts result from prolonged periods of dry weather accompanied by extreme heat and usually occur during the summer months (July and August) in Calvert County when high pressures settle in with prevailing dry west to southwest winds. The warmest time of the year is July when maximum temperatures average 87 degrees. Extreme temperatures of 100 degrees occur occasionally. Calvert County is subject to periodic droughts that may impact the county's ability to meet all of its water needs. The usual length of time does not exceed six weeks in mid-summer.

When drought begins, agriculture is usually first to be affected because of its heavy dependence on stored soil moisture. Soil moisture can be rapidly depleted during extended dry periods. Dry land farming and ranching are the most at risk from drought. Water uses depending on in-stream flows, such as irrigated farms; aquatic, wetland, and riparian environmental communities; and recreational uses are at high risk but less exposed. Urban and agricultural water users who rely on reservoirs and wells that are not dependent on high rates of aquifer recharge are the last to feel the effects.

Potential Damages and Impacts

Economic losses associated with drought are associated with reductions in agricultural production, livestock production, fisheries, recreation, tourism, and water consumption. Environmental drought impacts affect both human and animal habitats. Decreased flows in streams and rivers can affect salinity, bacteria, turbidity, pH, and lead to temperature increases.

Ground water is the most commonly used source of water supply and is obtained from both confined and unconfined aquifers. In fact some regions of the State like Southern Maryland and the Eastern Shore rely exclusively on ground water for their water needs. According to the latest figures, there are some 20,732 well users in Calvert County.

As of late 2010, the most recent crop data from the 2007 Census of Agriculture indicates the total acreage of lands designated for agricultural use has decreased 12 percent (from 30,023 acres to 26,443 acres). Crops harvested included 3,200 acres of corn, 3,200 acres of soybeans, and 3,000 acres of hay. Total crop sales value for the reporting period was $4,052,000 (including livestock). Drought-related agricultural losses can be estimated using average crop revenue per acre with an assumed reduction of 50 percent.

http://www.nass.usda.gov/Statistics_by_State/Maryland/County_Profiles/Calvert.pdf
http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/County_Profiles/Maryland/cp24009.pdf

History

Based on the monthly Palmer Drought Severity Index (PDSI) as computed by the National Climatic Data Center, the Lower Southern Climate Division (which includes Calvert County) has experienced 12 periods of 2 or more months of severe or extreme drought (Table 9). The PSDI uses temperature and precipitation data to calculate water supply and demand, incorporates soil moisture, and is considered most effective for unirrigated cropland. It primarily reflects long-term drought and has been used extensively to initiate drought relief.

**Table 9: Periods of Severe or Extreme Drought**

| Drought Periods | Duration | Lowest PDSI | Drought Periods | Duration | Lowest PDSI |
|---|---|---|---|---|---|
| 7/1930 – 2/1931 | 8 months | -6.09 in 2/1931 | 11/1941 – 2/1942 | 4 months | -3.71 in 12/1941 |
| 4/1942 – 5/1942 | 2 months | -3.72 in 5/1942 | 7/1954 – 3/1955 | 9 months | -4.36 in 1/1955 |
| 11/1965 – 8/1966 | 10 months | -4.49 in 8/1966 | 6/1986 – 7/1986 | 2 months | -3.55 in 7/1986 |
| 9/1986 – 10/1986 | 2 months | -3.36 in 10/1986 | 7/1991 – 2/1992 | 8 months | -3.99 in 11/1991 |
| 10/1998 – 2/1999 | 5 months | -4.60 in 12/1998 | 5/1999 – 7/1999 | 3 months | -4.23 in 7/1999 |
| 7/2002 – 9/2002 | 3 months | -4.25 in 9/2002 | 8/2007–3/2008 | 8 months | -4.19 in 1/2008 |

*http://www.nrcc.cornell.edu/drought/MD_drought_periods.html*

The 1930-31drought was one of the most severe droughts in Maryland's history. This was the driest period on record with precipitation totaling from 15 to 26 inches below normal. The drought caused $40 million dollars (1930 dollars) in losses to farmers in Maryland alone. Forest fires caused by the dry spell caused $580,000 in losses in Maryland. During the mid-1960's, Maryland again suffered from severe drought conditions when precipitation totals in the area were 10 to 19 inches below normal. That

period of drought was part of the longest drought to plague Maryland, lasting nearly 4 years.

The 1998-99 drought was comparable in severity to the 1960's drought and while it did not last as long as the 1960's drought and was not as severe as the 1930-31 drought, the 1998-99 drought caused a number of problems for Maryland residents and businesses. Crop damages were estimated in thousands of dollars per acre, and included damage assessments from corn, soybean, hay, and tobacco. For the first time in its history, Maryland declared a statewide drought emergency and implemented mandatory water restrictions.

Between June 1998 and August 1999, Calvert County sustained approximately $7.6 million in property and crop damage from drought conditions. The map shown in Figure 3, illustrates that most of the State of Maryland was in extreme drought conditions during this time. Persistent high pressure over the Southeast U.S. forced most rain producing low pressure systems to steer north of the region. Private water wells were affected in Calvert County and farmers throughout Maryland reported adverse growing conditions.

Since 1999, no damages have been reported in Calvert County or the towns as a result of drought conditions.

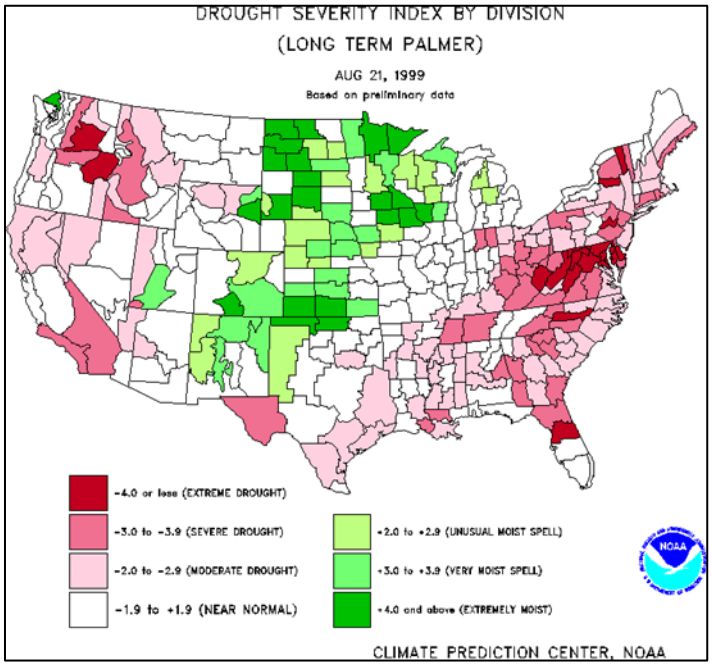


**Figure 3: Drought Severity Index (8-21-99)**

*http://www.atmos.umd.edu/~climate/drought.html*

Probability

Extended periods of little or no precipitation will lead to drought conditions. This hazard will affect the entire county and the towns. The Calvert County water supply primarily depends upon withdrawals from underground aquifers. Increased consumptive demands coupled with reduced recharge of these aquifers would lead to manifestation of drought related potable water shortages.

Based on the monthly Palmer Drought Severity Index (Table 10) as computed by the National Climatic Data Center, Calvert County is predominantly a “wet” region, with less than 14% of the time spent in Moderate, Severe, or Extreme drought conditions; however, given historical weather patterns, there is a moderate probability that the county will experience periods of drought in the future.

**Table 10: PDSI Category**

| Lower Southern Climate Division | | |
|---|---|---|
| **PDSI Category** | **Percent of Time in Category** | **Cumulative Percent Time** |
| Extreme | 1.1 | 1.1 |
| Severe | 3.9 | 5.0 |
| Moderate | 9.1 | 14.0 |
| Mild | 17.1 | 31.1 |
| Incipient | 12.1 | 43.2 |
| Near Normal | 16.2 | 59.4 |
| Wet | 40.6 | 100.0 |
| Lowest PDSI in 1389 months | -6.09 in 2/1931 | |

http://www.nrcc.cornell.edu/drought/MD_pdsi_smry.html

## *Earthquake*

Overview

An earthquake is a shaking or sometimes violent trembling of the earth that results from the sudden shifting of rock beneath the earth's crust. This sudden shifting releases energy in the form of seismic waves or wave-like movement of the earth's surface. Earthquakes can strike without warning and may range in intensity from slight tremors to great shocks.

Earthquakes are measured by two principal methods: seismographs and human judgment. The seismograph measures the magnitude of an earthquake and interprets the amount of energy released on the Richter scale, a logarithmic scale with no upper limit. This amount is expressed in Arabic numbers and each unit of increase represents a ten-fold increase in magnitude. An earthquake measuring 6.0 on the Richter Scale is ten times more powerful than a 5.0 and 100 times more powerful than an earthquake measuring 4.0. This is a measure of the absolute size or strength of an earthquake and does not consider the effect at any specific location. The Modified Mercalli Intensity Scale (MMI) is an intensity scale expressed in Roman numerals, which reports the amount of shaking and effects at a specific location based on expert judgment. The scale has twelve classes and ranges from I (not felt) to XII (total destruction).

Table 11 shows a comparison of the two scales.

**Table 11: Earthquake Magnitude and Intensity Scales**

| Magnitude (Richter) | Intensity (Mercalli) | Description |
|---|---|---|
| 1.0 – 3.0 | I | I. Not felt except by a very few under especially favorable conditions. |
| 3.0 – 3.9 | II – III | II. Felt only by a few persons at rest, especially on upper floors of buildings.<br>III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it is as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| 4.0 – 4.9 | IV – V | IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably.<br>V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop |
| 5.0 – 5.9 | VI – VII | VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.<br>VII. Damage negligible in buildings of good design and construction; slight in well-built ordinary structures; considerable damage in poorly built or badly designed structures. Some chimneys broken. |
| 6.0 – 6.9 | VII– IX | VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments and walls. Heavy furniture overturned.<br>IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Building foundations shifted. |
| 7.0 and higher | VIII or higher | X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.<br>XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.<br>XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air. |

*http://earthquake.usgs.gov/learn/topics/mag_vs_int.php*

Another way of measuring the potential damage of an earthquake is the peak ground acceleration (PGA). The PGA is measured as a percentage and refers to the maximum percentage of acceleration of the movement of the ground. A higher PGA means a more rapid movement of the ground and a higher probability of structural damage. Table 12 provides a comparison between the Modified Mercalli Intensity scale and peak ground acceleration.

**Table 12: Modified Mercalli Intensity Scale and Peak Ground Acceleration Comparison**

| MMI | Acceleration (%g) PGA | Perceived Shaking | Potential Damage |
|---|---|---|---|
| I | <0.17 | Not Felt | None |
| II – III | 0.17 – 1.4 | Weak | None |
| IV | 1.4 – 3.9 | Light | None |
| V | 3.9 – 9.2 | Moderate | Very Light |
| VI | 9.2 – 18 | Strong | Light |
| VII | 18 – 34 | Very Strong | Moderate |
| VIII | 34 – 65 | Severe | Moderate to Heavy |
| IX | 65 – 124 | Violent | Heavy |
| X – XII | >124 | Extreme | Very Heavy |

***Source: United States Geological Survey***

Earthquakes can last from a few seconds to over 5 minutes and they may also occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris, because the shocks from the earthquake shake, damage or demolish buildings and other structures. Disruption of communications, electrical power supplies and gas, sewer and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides or releases of hazardous material, compounding their disastrous effects.

Historic Activity

According to the USGS and the Maryland Geological Survey, the earliest recorded earthquake in Maryland occurred in Annapolis, on April 24, 1758, and lasted for 30 seconds and was reportedly felt as far away as Pennsylvania. In addition, the great earthquake series of 1811 -1812 centered near New Madrid, Missouri, affected an area of 2 million square miles, including Maryland. Since 1885, earth vibrations felt in Maryland have been associated with sources for adjacent states and points as far away as the St. Lawrence Valley and Ontario, Canada. Other earthquakes that were most likely felt in Calvert County include the following:

- 1828 – A moderate-sized earthquake was felt over all of Virginia, West Virginia, and portions of neighboring states, including Maryland. The effects at Baltimore resulted in considerable shaking of doors and agitation of other objects. The center of this earthquake was not accurately fixed, but it was probably in southwest Virginia.
- 1833 – Another shock centered in Virginia was felt noticeably in Baltimore.
- 1852 – A moderate shock in southwestern Virginia. Considerable alarm was noted in Baltimore, while residents in Annapolis reported merely feeling the tremor.
- 1886 –The great earthquake near Charleston, South Carolina, affected a total area with a radius of about 800 miles, including all of Maryland.
- 1897 – The most severe earthquake in Virginia's history (Giles County) shook an area of about 280,000 square miles. Baltimore and southern Maryland along the eastern shore reported distinct shaking.
- 1918 – An earthquake centered near Luray, Virginia, reached many points in Maryland.
- 1925 – A magnitude 7.0 earthquake centered in the St. Lawrence River region near Murray Bay, Canada, caused only moderate intensity effects, but was remarkable for the large area affected, which included all of eastern Canada and portions of the United States south of Virginia and west to the Mississippi River. This area covered approximately 2 million square miles. Damage was confined to a narrow belt on both sides of the St. Lawrence River. Residents in Baltimore and Overlea reported this earthquake as being felt lightly.
- 1935 – Another Canadian earthquake with magnitude 6.25 , near Timiskaming, resulted in only minor damage in the nearby region, but was felt over a great area, extending as far south as Washington, D.C., and as far west as Wisconsin. Felt points in Maryland included Chestertown (intensity IV), Annapolis, Baltimore, Bel Air, Cumberland, Frederick, Hancock, Havre De Grace, Laurel, and Westminster (intensity III or lower).

- 1944 – Another earthquake in the St. Lawrence River region reached to Maryland and Pennsylvania and west to Michigan and caused estimated $2 million damage in the epicenter area. Baltimore City and Westminster, Maryland, were near the extreme southern points reporting this earthquake.
- 1969 – A single felt report was received from West Hyattsville of an earthquake (magnitude 4.3) near Elgood, West Virginia.
- 1973 – Residents throughout a broad area of the middle-Atlantic region of the United States were jolted out of their sleep by shock waves from a minor earthquake near the Delaware – New Jersey – Pennsylvania border. Numerous points in northeastern Maryland reported this earthquake.
- 2003 – A 4.3 magnitude earthquake was centered near Richmond, VA and was felt throughout the Washington-Baltimore area.
- 2010 – A 3.6 magnitude earthquake centered near Germantown, MD was felt throughout Virginia and Maryland.
- *2011** -– A 5.8 magnitude earthquake centered near Mineral, VA was felt as far north as Canada and as far south as Georgia. Moderate damage was reported in Calvert County and the Emergency Operations Center was activated in response to the event. ** This event occurred after the planning period for this update but was a significant event for Calvert County.*

No earthquakes have been centered in Calvert County and although numerous earthquakes have reportedly been felt in the county, there have not been any reported damages associated with these past events.

Probability

The probability of an earthquake being felt in Calvert County is low (14 events in 250 years); moreover, the perceived shaking would be light and minimal damages would be expected to ensue. Figure 4 is the 2008 U.S. Geological Survey (USGS) National Seismic Hazard Map displaying earthquake ground motion, or PGA, with a frequency level of 2% over a 50-year period. As shown, much of Maryland is in an area of low seismic hazard, with expected peak ground acceleration of just 4% to 8% over the 50-year time frame. The map is derived from seismic hazard curves calculated on a grid of sites across the United States that describe the frequency of exceeding a set of ground motions.

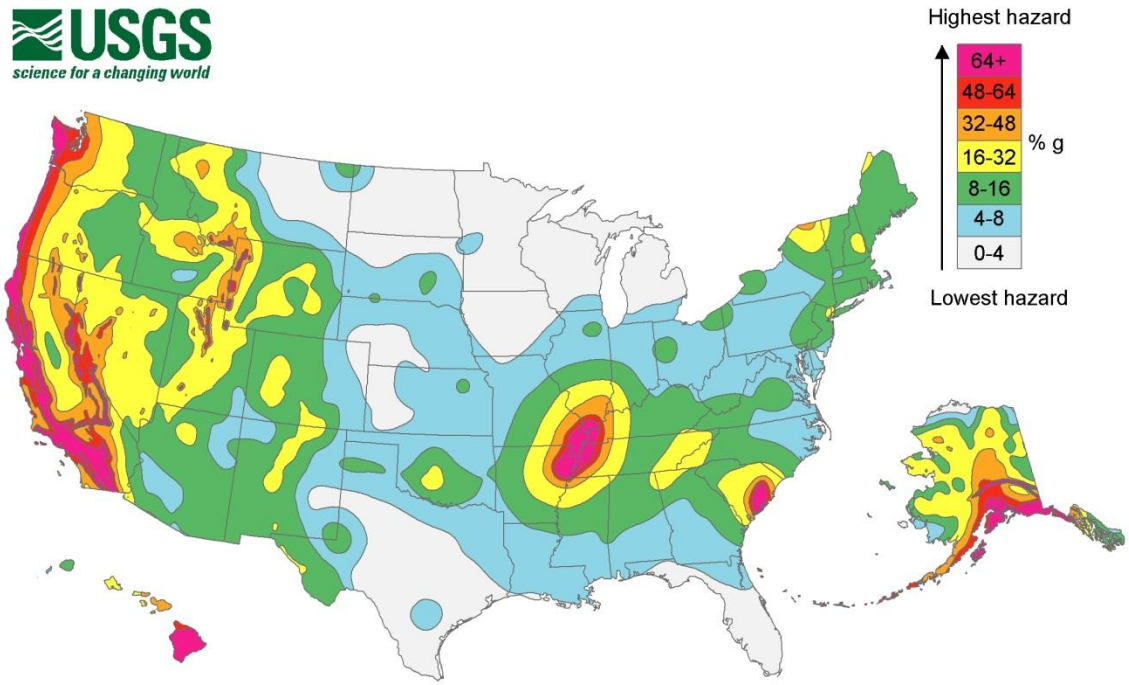


**Figure 4: USGS Peak Ground Acceleration Probability of 2% in 50 Years**

*http://www.atmos.umd.edu/~climate/drought.html*

### *Extreme Summer Heat*

Overview

Temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks are defined as extreme heat. A heat wave is primarily a public health concern as structures and infrastructures are rarely impacted. During extended periods of very high temperatures or high temperatures with high humidity, individuals can suffer a variety of ailments including heat cramps, heat syncope, heat exhaustion, and heat stroke.

- **Heat stroke,** in particular, is a life threatening condition that requires immediate medical attention. It exists when the body's core temperature rises above 105°F as a result of environmental temperatures. Patients may be delirious, stuporous, or comatose. The death-to-care ratio in reported cases in the US averages about 15%.
- **Heat Exhaustion** is much less severe than heat stroke. The body temperature may be normal or slightly elevated. A person suffering from heat exhaustion may complain of dizziness, weakness or fatigue. The primary cause of heat exhaustion is fluid and electrolyte imbalance. The normalization of fluids will typically alleviate the situation.
- **Heat Syncope** is typically associated with exercise by people who are not acclimated to exercise. The symptom is a sudden loss of consciousness.

Consciousness returns promptly when the person lies down. The cause is primarily associated with circulatory instability as a result of heat. The condition typically causes little or no harm to the individual.

- **Heat Cramps** are typically a problem for individuals who exercise outdoors but are unaccustomed to heat. Similar to heat exhaustion, it is thought to be a result of a mild imbalance of fluids and electrolytes.

In 1979, R.G. Steadman, a meteorologist, developed the heat index which is shown in Table 13 to illustrate the risk associated with extreme summer heat.

**Table 13: Heat Danger Categories**

| Danger Category | Heat Disorders | Apparent Temperature (°F) |
|---|---|---|
| IV Extreme Danger | Heatstroke or sunstroke imminent. | >130 |
| III Danger | Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and physical activity. | 105-130 |
| II Extreme Caution | Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and physical activities | 90-105 |
| I Caution | Fatigue possible with prolonged exposure and physical activity. | 80-90 |

Historic Activity

Fourteen extreme heat events have been reported in Calvert County since 1996, as reported through the National Climatic Data Center. Also of significance to this historic record, in a statewide heat wave in 1930, temperatures reached 106 degrees in Calvert County (Figure 5).

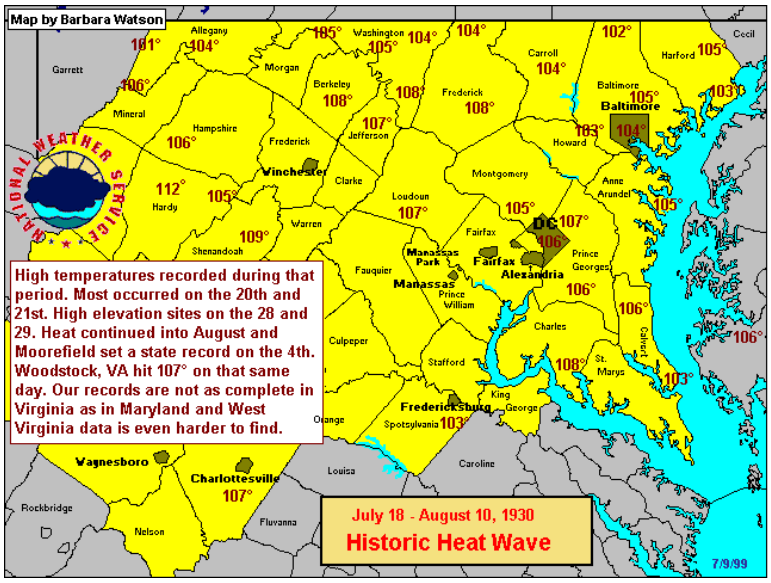


**Figure 5: Historic Heat Wave (1930)**

*http://www.erh.noaa.gov/er/lwx/Historic_Events/StormsOfCentury.html*

Events in the NCDC database include May, 1996, July 1997, August 1997, July 1999, June 2001, August 2001, July 2002 (3 events), August 2002 (3 events), July 2006, and August 2006. For the 13 county reporting areas which include Calvert County, total deaths for these 14 events totaled 72, total injuries totaled 398, while crop damages and property damages were not indicated. The most severe examples of extreme heat in Calvert County include the following:

- August 1995, dry weather, combined with periods of excessive heat, caused substantial damage to several crops and threatened livestock.

- July and August 1997, high temperatures in most places reached over 100 degrees, while dew point temperatures (an indication of how humid the air mass is) were well into the 70s. Three deaths and 150 injuries were reported.
- July 1999, high pressure sat off the Mid-Atlantic coast from the 4th through the 7th, acting like a heat pump drawing in extremely warm and humid air. Temperatures on the 4th through early on the 7th were oppressively hot, and extremely humid conditions added to the misery. These conditions continued until a cold front swept through the area during the afternoon of the 7th, ushering cooler and much less humid air. The mercury soared into the upper 90s to lower 100s during the period. Dew points were in the lower to middle 70s, creating heat indices between 100 and 115 degrees. Nighttime lows only dipped into the 70s and heat index values remained in the upper 70s to middle 80s. Road surfaces and cars also fell victim to the heat. There were 15 deaths in the 13 county reporting areas, and 241 reported injuries.
- July 2, 2002, high pressure remained stationary off the Delmarva coastline during the 1st week of July. This resulted in a prolonged period of hot and humid weather across the Mid-Atlantic region. Between July 2nd and 4th, high temperatures rose into the lower to middle 90s and dew points reached into the lower 70s. This resulted in heat index values reaching 100 to 110 degrees during the afternoon. In addition, heat index values only dropped into the middle 80s overnight, resulting in little relief for people without air conditioning. These conditions led to several heat related deaths and illnesses, especially in people already suffering from pre-existing medical conditions.

Probability

The temperature variances between the north and south ends of the county and the bay and river sides usually vary by no more than a couple of degrees. For this reason, extreme summer heat would be expected to impact the entire county and the towns uniformly. The probability of occurrence is moderate given the historical weather patterns. Transient, low or fixed income and elderly populations are at the greatest risk from exposure to extreme heat conditions.

### *Flooding*

Overview

Flash floods, as the name suggests, occur suddenly after a brief but intense downpour. They move fast and terminate quickly. Although the duration of these events is usually brief, the damages can be quite severe. Flash floods may also result as a secondary effect from other types of disasters, including wildfires and dam breaks. Wildfires remove vegetative cover and alter soil characteristics, increasing the quantity and velocity of stormwater runoff, and dam breaks release large quantities of water into receiving drainage ways in a very short timeframe. Flash floods are the number one weather-related killer with approximately 140 deaths recorded in the United States each year.

Coastal flooding occurs when water is pushed inland by severe weather events along the coast. The extent of the flooding is dependent on the inland elevations in the impacted areas. Calvert County is susceptible to these events due to its low elevations in the coastal areas. Coastal flooding is often caused by nor’easters and tropical systems and is now being impacted by fluctuations in water levels attributed to sea level rise.

Riverine floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies use historical records to determine the probability of occurrence for different extents of flooding. The probability of occurrence is expressed as the percentage chance that a flood of a specific extent will occur in any given year. On the other hand, flash floods cannot be predicted accurately and happen whenever there are heavy storms. Smaller floods occur more often than larger and more widespread ones. Table 14 shows a range of flood recurrence intervals and their probabilities of occurrence. So every year, a 10-year flood has a greater likelihood of occurring (10% chance) than a 100-year flood (1% chance).

**Table 14: Flood Probability Terms**

| Flood Recurrence Intervals | Chance of occurrence in any given year |
|---|---|
| 10 year | 10% |
| 50 year | 2% |
| 100 year | 1% |
| 500 year | 0.2% |

The extent of flooding associated with a 1% annual probability of occurrence – also referred to as the "base flood" - is used as the regulatory floodplain boundary by a number of federal, state and local agencies. Also referred to as the "Special Flood Hazard Area", this boundary is a convenient tool for assessing vulnerability and risk in flood prone communities since many communities have maps available that show the extent of the base flood and likely depths that will be experienced. The base flood is often referred to as the "100-year flood." It is important to note that after an area is impacted by a 100-year flood, this does not mean a similar magnitude flood cannot happen for the next 99 years.

Flash floods are more likely to occur in places with steep slopes and narrow stream valleys, and along small tributary streams. In urban areas, parking lots and other impervious surfaces that shed water rapidly contribute to flash floods. In rugged, hilly, and steep terrain, the high-velocity flows and short warning times make these floods hazardous and very destructive. Flash floods could also be a result of improper drainage. Other causes of floods and flash floods are shown in Table 15.

**Table 15: Flooding vs Flash Floods – Causes**

| Causes of Flooding | Causes of Flash Floods | Causes of Coastal Floods |
|---|---|---|
| Low lying, relatively undisturbed topography | Hilly/mountainous areas | Sea level rise and/or land subsidence |
| High season water tables | High velocity flows | Storm surge associated with tropical storms or nor'easters |
| Poor drainage | Short warning times | Improper drainage combined with abnormally high tides |
| Excess paved surfaces | Steep slopes | |
| Constrictions – filling | Narrow stream valleys | |
| Obstructions – bridges | Parking lots & other impervious surfaces | |
| Soil characteristics | Improper drainage | |

Historic Activity

According to the National Climatic Data Center, twenty two flooding events have occurred in Calvert County since 1950 with twelve of these events occurring in Calvert County between 2004 and 2010. These events are shown in Table 16.

**Table 16 : Calvert County Flood Events, 1950-2010**

| Location or County | Date | Time | Type |
|---|---|---|---|
| 1 CALVERT | 03/04/1993 | 1100 | Flood/flash Flood |
| 2 CALVERT | 11/28/1993 | 0600 | Coastal Flooding |
| 3 NW Border | 06/24/1995 | 1200 | Flash Flood |
| 4 Prince Frederick | 06/20/1996 | 12:50 PM | Flash Flood |
| 5 Countywide | 01/28/1998 | 11:00 AM | Flood |
| 6 MDZ014 - 016>018 | 02/04/1998 | 08:00 AM | Coastal Flooding |
| 7 Countywide | 02/04/1998 | 08:00 AM | Flood |
| 8 Countywide | 09/16/1999 | 08:00 AM | Flash Flood |
| 9 Countywide | 07/26/2000 | 12:00 PM | Flash Flood |
| 10 North Portion | 09/02/2000 | 02:30 PM | Flash Flood |
| 11 Dunkirk | 06/25/2004 | 03:30 PM | Flash Flood |
| 12 MDZ004>006 - 009>010 - 016 - 018 | 01/14/2005 | 05:30 AM | Flood |
| 13 Chesapeake Beach | 06/26/2006 | 01:00 AM | Flash Flood |
| 14 MDZ017 - 018 | 05/11/2008 | 21:00 PM | Coastal Flood |
| 15 Long Beach | 05/12/2008 | 00:00 AM | Flood |
| 16 North Beach | 08/22/2009 | 17:00 PM | Flash Flood |
| 17 North Beach | 08/22/2009 | 17:00 PM | Flash Flood |
| 18 Owings | 08/22/2009 | 17:00 PM | Flash Flood |
| 19 MDZ018 | 11/12/2009 | 17:25 PM | Coastal Flood |
| 20 North Beach | 09/30/2010 | 04:31 AM | Flash Flood |
| 21 Appeal | 09/30/2010 | 16:00 PM | Flash Flood |
| 22 Stoakley | 09/30/2010 | 21:17 PM | Flash Flood |

*Source: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms*

In regard to past flood events, Calvert County experienced its worst flooding as a result of nor'easters, tropical storms and hurricane events. They bring torrential rains and high winds and often cause flash flooding as well as overbank flooding of inland streams and rivers.

In 1972, flooding related to an unnamed tropical storm resulted in over $2 million in property damage and an additional $21,736 in crop damages.

Some past flooding events in Calvert County include the following:

- October 1954 – On October 21st, 1954, Hurricane Hazel hit Calvert County. The Solomons and North Beach areas of the county were affected the most by the damaging tides, which were six to eight feet above the normal tidal range. The hurricane caused thousands of dollars' worth of damage to barns, tobacco plants, businesses, and residential homes
- August 1955 – Hurricane Connie struck Calvert County on August 18, 1955, The Hurricane caused widespread damage with flooding occurring along the Chesapeake Bay; this was caused by the storms heavy rainfall, over 9.5 inches, and the above normal tides. The flooding filled many wells and caused extensive damage to homes, specifically filling basements. There were at least 12 known deaths directly related to the storm's damage on land and 14 people lost their lives when the Levin J. Marvel, a large schooner was wrecked by the storm.
- October 1971 – A strong thunderstorm blew through the Calvert area causing flooding, road closings and power outages. Route 261 was completely flooded due to the effects of the storm. The storm resulted in approximately $50,000 of crop damage and $10,000 of property damage.
- September 1979 – Tropical Storm David moved through the Calvert area on September 5, 1979, resulting in damage of over two million dollars. The major flood damage was confined to the northern portions of the county, especially the low-lying twin beach area. The Kenwood Beach area was hit with over six inches of rain, which caused collapsed retaining walls, flooded basements, and washed out roads in and around the development.
- November 1985 – On Wednesday, November 4, 1985, a severe thunderstorm brought rain, wind, and high tides to the Calvert area. There were four foot waves battering the shoreline and tides of three to four feet above normal; this caused many residents of low lying areas to evacuate. The flooding damaged businesses, homes, roads, and piers, many places were still flooded two days later which delayed damage reports. The major damage occurred around North Beach, along Atlantic Avenue where decks and porches were ripped from their foundations. The Chesapeake Beach area sustained less damage than the North Beach area, but was flooded for days after the storm. Most of the damage was confined to North Beach, Chesapeake Beach, Broomes Island, Neeld Estates, Willows Colony, Kenwood Beach, Long Beach, and Cove Point, with damages in excess of $1.5 million dollars. Approximately 150 homes were affected by the storm, 2,500 feet of seawall was destroyed, and the estimated road damage was over $30,000.
- June 1995 – A nearly stationary thunderstorm dumped six inches of rain into Lyons Creek along the Calvert/Anne Arundel county boundary causing minor flash flooding to ensue. Damage was minimal.
- September 1996 – On September 6, 1996, Tropical Storm Fran passed through Maryland just west of Calvert County. The hardest hit areas of the county were North Beach, Breezy Point, Hallowing Point and Broomes Island. High winds and surging tides brought flood damage to many homes in these areas. There were at least 60 residences which sustained flood damage. The worst hit were three

homes on Annapolis Avenue in North Beach and four apartments in Hallowing Point. In addition to residential damage, many roads in Solomon's Island were flooded. The damage for the Calvert area was estimated at $750,000.00.

- January 1998 – A fairly intense and slow-moving nor'easter produced a large area of moderate to heavy rains across central and lower Southern Maryland. Storm totals ranged from 3 and 4 inches across lower Southern Maryland. Widespread minor to moderate flooding of small streams, creeks, and low-lying areas occurred over much of lower southern Maryland. Numerous roads were closed in these areas. A local National Weather Service (NWS) cooperative observer noted nearly 6.5 inches in a five-day period, with 3.96 inches from the nor'easter alone. Though no coastal flooding was observed, there was some minor overwash at Chesapeake Beach. Channeling northerly winds down the bay reduced the flood threat, especially since tides were astronomically high. These same northerly winds, blowing at gale force, built waves in the bay to 5 feet or more. Unfortunately, these waves aided in sinking a tugboat 1.5 miles northeast of the Thomas Point Lighthouse. The three-man crew was rescued. In Calvert County, two homes sustained minor damage from fallen trees. Numerous other trees/limbs and wires were down across Calvert County. Reported property damage was estimated to be $5,000 according to the NCDC, but total damages were likely higher.
- September 1999 – 7 swift water rescues were completed in Maryland as a result of Hurricane Floyd when local roads were flooded. Tidal flooding was reported along the Chesapeake Bay. Strong southerly winds ahead of the hurricane pushed tides 2 to 3 feet above normal, flooding several low lying areas in Calvert County. Numerous shoreline homes between 2 and 4 feet above sea level were flooded in the county.
- July 2000 – Showers and thunderstorms produced very heavy rainfall and flooded numerous roads. In Calvert County, residents of Breezy Point, North Beach, Chesapeake Beach, Drum Point, and Cove Point reported flooded roadways and yards.
- September 2000 – Slow moving thunderstorms produced heavy rainfall and damaging lightning across portions of central Maryland during the afternoon of the 2nd. In Calvert County, law enforcement officials reported cars floating off Mt. Harmony Road after water rapidly rose. Routes 4 and 260, in addition to roads in Dunkirk, Owings, and North Beach, were inundated by water. A total of 1.25 inches of rain was reported in Dunkirk where lightning strikes damaged two homes and a fire station
- September 2003 – Tropical Storm Isabel raged through Maryland, hitting Calvert County on September 18$^{th}$. The storm surge that came with Isabel was five to nine feet above normal. In North Beach, a house was moved off its foundation. The pier at Solomons Island was completely demolished. Approximately 22,400 customers were left without power in the county and the hospital saw an additional 130 patients per day. Over 100 homes sustained major damage and a few were completely destroyed. Residents who had lived in the area for 80 years felt that Isabel caused more damage than the 1933 Hurricane, which created the Ocean City Inlet.
- June 2006 – Scattered areas of flash flooding began on June 23 and continued into June 24. Thunderstorms affected the area on June 26 and flooding began to

take on a more serious nature as the ground became saturated in many locations. A mudslide occurred on B Street near the boardwalk in Chesapeake Beach.

- September 2006 – Tropical Depression Ernesto brought high winds and heavy rain to the area on September 1, 2006, also affecting water quality of the Chesapeake Bay. During the storm, the Chesapeake Beach Wastewater Plant released approximately 1.5 million gallons of wastewater into the Chesapeake Bay. Many trees were uprooted during the storm's rage including an historic red oak in Dunkirk.
- May 2008 – Calvert County was impacted by heavy rain and flooding on May 11th and 12th. Rainfall amounts totaled over 4 inches. This coupled with high tides caused flood damage to many residential buildings. The North Beach area was hit the hardest by flooding. Cars parked on Bay Avenue were partially submerged and Route 261 in North Beach was impassable due to the flood waters. In the Long Beach area, a few houses were battered by surging waves. The Hallowing Point Trailer Park had to be evacuated due to the Patuxent River's rising waters.

Flood Insurance

As part of Calvert County's participation in the NFIP, residents and businesses are eligible to obtain flood insurance policies. As of December 2010, there were 512 NFIP policies in effect in Calvert County. The policies' combined written coverage was $144,216,400, with a total annual premium of $416,907. Calvert County and North Beach both enrolled in the NFIP effective September 28, 1984, while Chesapeake Beach enrolled November 1, 1984.

In the incorporated areas of the Town of Chesapeake Beach and the Town of North Beach, there were 189 and 87 policies in effect, respectively. The Town of Chesapeake Beach's policies have a total coverage of $55,708,200, with a total premium of $144,985, while the Town of North Beach has a total coverage of $23,861,300, with a total premium of $80,009.

As of December 31, 2010, the NFIP had paid $4,404,662 to residents and businesses in the county for a total of 291 total losses. The residents and businesses in the Town of Chesapeake Beach and the Town of North Beach have received payments of $1,548,209, and $2,624,695, for 65 and 95 losses, respectively. These policies include both "direct" and "write-your-own" types. Although exact numbers for Calvert County were not available, national patterns indicate that:

- 68% of polices are for single family residential properties,
- 20% of policies are for residential condominiums,
- 4.5% are written for non-residential structures,
- 4% are for multi-family residences, and
- Less than 4% are for other various residential categories.

The study assumes that Calvert County and the incorporated municipalities follows similar patterns for its total of 788 policyholders.

Calvert County joined the Community Rating System (CRS) in October 1991, but rescinded from the program in 1996. The Town of North Beach joined the CRS in January 1992, but rescinded from the program in 2008. Neither Calvert County, the

Town of Chesapeake Beach, nor the Town of North Beach currently participates in the CRS, however, based on the number of policies and the quantity of annual premiums, even the basic policy cost reduction allowance of 5% would result in annual savings to policyholders estimated at $20,925, $7,429, and $4,072 respectively.

The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. The Calvert County Department of Planning and Zoning anticipates returning to the CRS program in June 2013.

Repetitive Flood Losses

Repetitive loss properties are another means to identify areas with historic flood hazards. Associated with the NFIP, repetitive loss properties are defined as those properties having two or more flood insurance claims of $1,000 or more within any 10-year period beginning in 1978. As of January 1, 2011, there are 53 such properties in Calvert County including 3 properties in the Town of Chesapeake Beach and 11 properties in the Town of North Beach. Review of repetitive loss locations serves as a rough indicator of flood hazard concern areas but could inadvertently lead to misdirected mitigation efforts. Repetitive loss properties only occur where the owner has or has had NFIP coverage. Areas defined strictly by NFIP repetitive flood losses may not include uninsured properties or properties where NFIP policy owners do not file claims, or do not make the $1,000 threshold. For this reason, any study analyses will use this tool as a means to supplement flood assessments.

The Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 amended the National Flood Insurance Act of 1968 to reauthorize the NFIP through 2008 and to establish and enhance programs to mitigate losses to repetitive loss properties. The Act increased the funding under the existing Flood Mitigation Assistance Program from $20 million a year to $40 million a year; modified current Increased Cost of Compliance insurance coverage to expand coverage and to allow its use as non-Federal cost share for mitigation projects.

The Act defined “severe repetitive loss properties” as insured 1-4 family residences that have had 4 or more claims exceeding $5,000 and cumulatively exceeding $20,000, or which have had at least 2 claims that cumulatively exceed the building value. If a mitigation action is proposed for a severe repetitive loss property and the offer is turned down, the chargeable premium rate for the property is to be increased to 150% of the current premium. On each subsequent loss of more than $1,500, the premium is to increase to 150% of the premium at the time of the loss. Premiums are capped at the estimated risk premium rate for the area. Increased deductibles may be selected to offset the increased premiums.

Probability

Calvert County flood hazards are largely tied to geologic and topographic drainage features throughout the county and the location (horizontal and vertical) of structures relative to the floodplain.

When investigating the location of such hazards, typical practice analyzes the extent of large-scale design events on a community. These design events are normally based on a 100-year probabilistic storm event, or an event that has a 1% annual chance of occurring. The area affected by this event is typically referred to as the floodplain.

As part of efforts under the NFIP, FEMA investigated the possible frequency and magnitude of flooding events within Calvert County. The results of these analyses by FEMA form the Calvert County Flood Insurance Study (FIS). The FIS applied computer models to predict flooding levels for the 100-year storm event. More recent studies by the US Army Corps of Engineers (USACE) have updated this information for the coastal area in North Beach. The dates of the most recent Flood Insurance Rate Maps (FIRM) provided by FEMA are as follows: Calvert County – December 16, 2011; Chesapeake Beach – December 16, 2011; and, North Beach – December 16, 2011. Flood damage to residences can be devastating, both emotionally and financially. Flood damage to businesses could result in loss of income, wages, and tax revenues. Other effects include outbreaks of disease, widespread animal illness, disrupted utilities, water pollution, fire, and wash away of roads and culverts.

The probability of occurrence is high given the historical weather patterns with a recurrence interval of one flood event every 2.7 years.

### *Hurricane and Tropical Storm*

Overview

Hurricanes and tropical storms, as well as tropical depressions, are all tropical cyclones defined by the NWS's National Hurricane Center (NHC) as warm-core, non-frontal synoptic-scale cyclones, originating over tropical or subtropical waters, with organized deep convection and a closed-surface wind circulation about a well-defined center. Once they have formed, tropical cyclones maintain themselves by extracting heat energy from the ocean at high temperatures and releasing heat at the low temperatures of the upper troposphere. Hurricanes and tropical storms bring heavy rainfalls, storm surge, and high winds, all of which can cause significant damage. These storms can last for several days, and therefore have the potential to cause sustained flooding, high wind, and erosion conditions.

Hurricanes are classified using the Saffir-Simpson Hurricane (Table 17) which rates the intensity of hurricanes based on wind speed and barometric pressure measurements, and is used by the NWS to predict potential property damage and flooding levels from imminent storms.

**Table 17: Saffir-Sampson Scale and Typical Damages**

| Category | Sustained Wind Speeds (Mph) | Surge (Ft) | Pressure (Mb) | Typical Damage |
|---|---|---|---|---|
| Tropical Depression | <39 | -- | -- | |
| Tropical Storm | 39-73 | -- | -- | |
| Hurricane 1 | 74-95 | 4-5 | > 980 | *Minimal* – Damage is done primarily to shrubbery and trees, unanchored manufactured homes are damaged, some signs are damaged, no real damage is done to structures on permanent foundations. |
| Hurricane 2 | 96-110 | 6-8 | 965-980 | *Moderate* – Some trees are toppled, some roof coverings are damaged, and major damage is done to manufactured homes. |
| Hurricane 3 | 111-130 | 9-12 | 945-965 | *Extensive Damage* – Large trees are toppled, some structural damage is done to roofs, manufactured homes are destroyed, and structural damage is done to small homes and utility buildings. |
| Hurricane 4 | 131-155 | 13-18 | 920-945 | *Extreme Damage* – Extensive damage is done to roofs, windows, and doors; roof systems on small buildings completely fail' some curtain walls fail. |
| Hurricane 5 | > 155 | > 18 | < 920 | *Catastrophic Damage* – Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, some buildings fail completely. |

Storm surge can be modeled by various techniques; one such technique is the use of the NWS's Sea, Lake and Overland Surges from Hurricanes (SLOSH) model. The model is used to predict storm surge heights based on hurricane category. Surge inundation areas are classified based on the category of hurricane that would cause flooding. As the category of the storm increases, more land area will become inundated. The 2006 storm surge map for Calvert County is available online at: http://www.iwr.usace.army.mil/nhp/HES/MD/MarylandWesternShore/Current2006HES/PDFsofInundationMaps/Calvert_County-StormSurgeMap.pdf and indicates those areas of the County at increased risk for inundation by storm surge. Figure 6 provides a small section of the map focused on the towns of Chesapeake Beach and North Beach, as the concentration of population and improved property in the storm surge zones is higher in these towns.

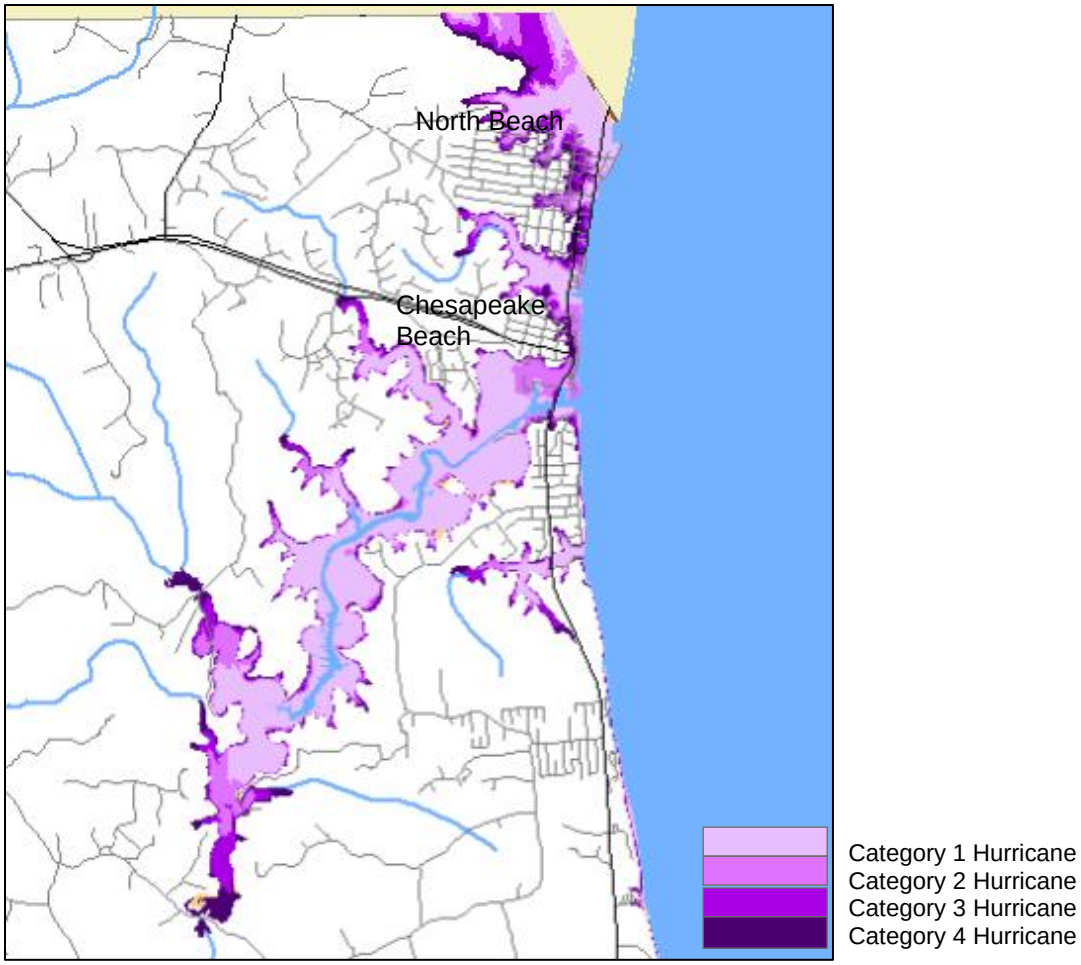


**Figure 6: Maryland Western Shore Hurricane Evacuation Study Storm Surge Map, Calvert County, Maryland (Chesapeake Beach and North Beach shown)**

Historic Activity

Calvert County has received 3 Presidential Declaration of Emergency for damages sustained by hurricanes and tropical storms.

A review of historical tracks of tropical weather systems indicates Calvert County has been affected by such storms 50 times since 1886. Figure 7 shows the paths of 5 storms passing over or within approximately 65 miles of Calvert County from 2000-2010 (Table 18 lists all of the storm events passing with 65 miles of Calvert County since 1900).

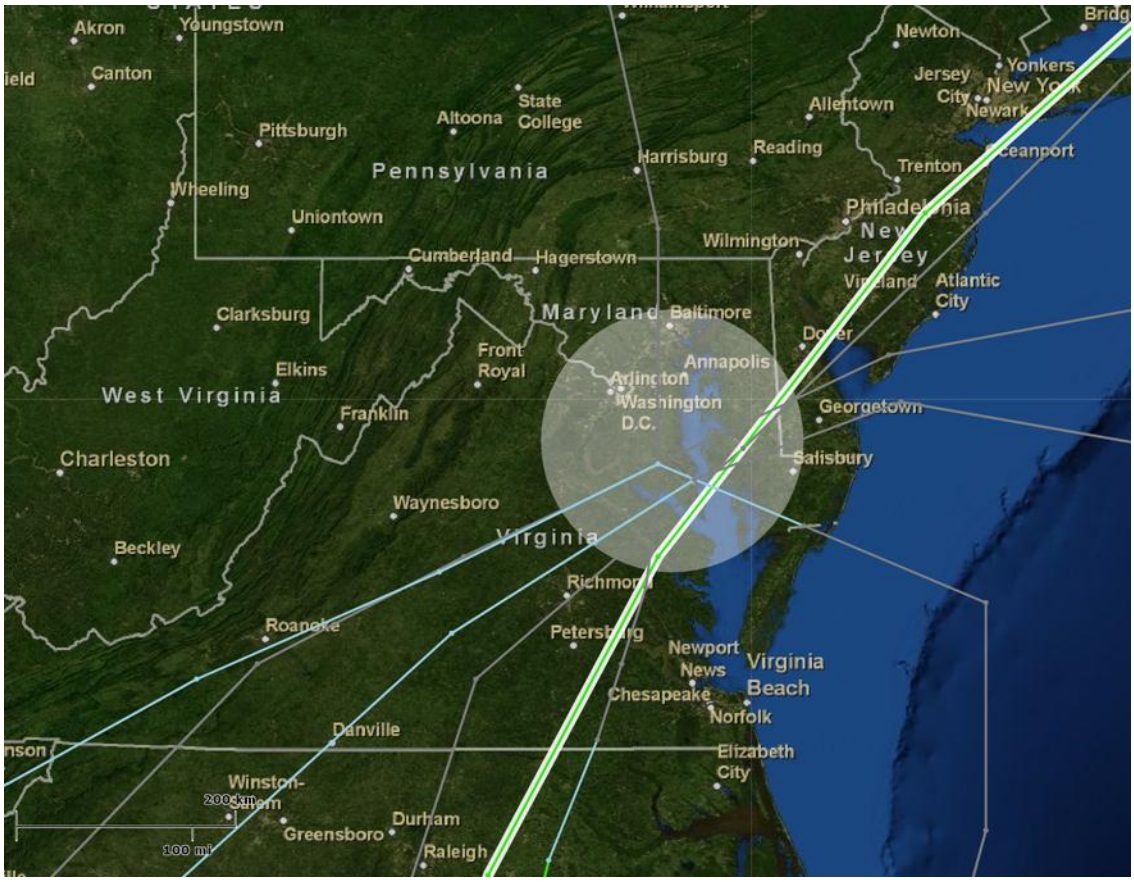


**Figure 7: Tropical Systems Passing with 65 Miles of Calvert County 2000-2010**

***Source:*** ***http://hurricane.csc.noaa.gov/hurricanes/viewer.htm***

The storms represented in the map above only represent hurricanes or tropical storms passing within the 65-mile radius from 2000-2010. Numerous severe storms have struck the Atlantic Coast both above and below Calvert County, including Bertha (1996), Floyd (1999), Isabel (2003), Ernesto (2006) and Hannah (2008). The earliest recorded hurricane dates back to 1667. Since 1900, there have been 37 tropical systems passing within a 65-mile radius of Calvert County.

**Table 18: Historical Coastal Storms Passing Within 65-Miles of Calvert County (1900-2008)**

| Year | Month | Day | Storm Name | Wind Speed(Kts) | Wind Speed(Mph) | Category |
|---|---|---|---|---|---|---|
| 1902 | 6 | 16 | Not Named | 40 | 45 | E |
| 1902 | 10 | 12 | Not Named | 35 | 40 | E |
| 1904 | 9 | 15 | Not Named | 55 | 65 | Ts |
| 1905 | 10 | 11 | Not Named | 25 | 30 | E |
| 1915 | 8 | 4 | Not Named | 30 | 35 | Td |
| 1923 | 10 | 24 | Not Named | 50 | 60 | E |
| 1924 | 9 | 30 | Not Named | 35 | 40 | E |
| 1927 | 10 | 4 | Not Named | 30 | 35 | Td |
| 1928 | 8 | 12 | Not Named | 30 | 35 | E |
| 1928 | 9 | 19 | Not Named | 40 | 45 | Ts |

| Year | Month | Day | Storm Name | Wind Speed(Kts) | Wind Speed(Mph) | Category |
|---|---|---|---|---|---|---|
| 1929 | 10 | 3 | Not Named | 35 | 40 | E |
| 1933 | 8 | 23 | Not Named | 50 | 60 | Ts |
| 1934 | 6 | 19 | Not Named | 40 | 45 | E |
| 1939 | 8 | 19 | Not Named | 25 | 30 | Td |
| 1943 | 10 | 1 | Not Named | 35 | 40 | Ts |
| 1944 | 8 | 2 | Not Named | 45 | 50 | Ts |
| 1944 | 10 | 21 | Not Named | 35 | 40 | E |
| 1945 | 9 | 18 | Not Named | 35 | 40 | Ts |
| 1952 | 9 | 1 | Able | 35 | 40 | Ts |
| 1955 | 8 | 13 | Connie | 60 | 70 | Ts |
| 1955 | 8 | 18 | Diane | 50 | 60 | Ts |
| 1960 | 7 | 30 | Brenda | 45 | 50 | Ts |
| 1961 | 9 | 14 | Unnamed | 35 | 40 | Ts |
| 1971 | 8 | 28 | Doria | 55 | 65 | Ts |
| 1971 | 10 | 2 | Ginger | 30 | 35 | Td |
| 1979 | 7 | 15 | Bob | 20 | 25 | Td |
| 1981 | 7 | 1 | Bret | 50 | 60 | Ts |
| 1983 | 9 | 30 | Dean | 55 | 65 | Ts |
| 1988 | 8 | 29 | Chris | 20 | 25 | Td |
| 1992 | 9 | 25 | Danielle | 55 | 65 | Ts |
| 1996 | 7 | 13 | Bertha | 60 | 70 | Ts |
| 2000 | 9 | 19 | Gordon | 25 | 30 | E |
| 2004 | 9 | 18 | Ivan | 15 | 20 | E |
| 2004 | 9 | 25 | Jeanne | 25 | 30 | E |
| 2005 | 7 | 8 | Cindy | 25 | 30 | E |
| 2006 | 9 | 2 | Ernesto | 40 | 45 | E |
| 2008 | 9 | 6 | Hannah | 45 | 50 | Ts |

Other hurricanes and costal storms that affected Calvert County include the following:

- August 23, 1933 – A huge, ocean-born twister that would come to be called the "Great Chesapeake-Potomac Hurricane", laid down an unprecedented path of destruction that roughly covered the area between Norfolk, Virginia and the Washington, D.C. Metro area. Fortunately, there were no reports of deaths, but a storm tide seven feet above normal flooded downtown Norfolk, and the damages in Maryland were estimated to be in the range of $17 million (1933) dollars. This hurricane was devastating to the economy of Solomons when the lower half of the island was submerged under water, oyster beds and packing houses were destroyed and the steamboat wharf was torn away. Many boats were washed away, damaged, lost or destroyed.
- In June, 1972 Tropical Storm Agnes struck Maryland, causing the flood of record for many communities in the central and western parts of the State.

- July 13, 1996 – Hurricane Bertha moved across the Lower Maryland Eastern Shore. The highest sustained wind speed recorded was 23 mph at Salisbury, but the Fenwick Island Buoy, which is just offshore along the Delaware-Maryland border, recorded a sustained wind speed of 47 mph. Numerous trees and power lines blown down resulted in scattered property damage and power outages. Rainfall amounts generally ranged from 3 to 5 inches and caused some street flooding.
- September 6, 1996 – Spiral bands associated with Hurricane Fran affected the Lower Maryland Eastern Shore. A storm surge of 4 to 6 feet was reported. Some minor flooding occurred in Somerset County. Tides were 2 feet above normal. Also, a few trees and power lines were blown down.
- October 8, 1996 – Remnants of Tropical Storm Josephine moved quickly up the East Coast affecting the Lower Maryland Eastern Shore. The storm produced 1.5 to 3.5 inches of rain resulting in flooding of several roads. Several trees and power lines were blown down resulting in some minor structural damage and scattered power outages. In addition, the storm's winds broke loose a 160-foot barge from its moorings.
- September 1999, Hurricane Floyd hit Maryland and resulted in property damage worth approximately $200,000. Hurricane Floyd made landfall just east of Cape Fear, North Carolina in the early morning hours of the 16th and moved north-northeast across extreme southeast Virginia to near Ocean City, Maryland. The eye of Hurricane Floyd passed east of the Chesapeake Bay between 9:00 AM and midnight on the 16th. Gusty winds of 30 to 50 mph blew across the area between 11:00 AM and midnight on the 16th, with localized wind gusts over 50 mph near the Chesapeake Bay. Hundreds of trees and power lines were downed and over 500,000 customers lost electricity. Between 8 and 12 inches of rain fell across St. Mary's, Anne Arundel, Calvert and Harford counties. The amount of damage Anne Arundel, Calvert, Charles, Harford, and St. Mary's counties received from the storm qualified them for FEMA disaster assistance. Tidal flooding was reported along the Chesapeake Bay. Strong southerly winds ahead of the hurricane pushed tides 2 to 3 feet above normal, flooding several low lying areas in St. Mary's, Calvert, Harford, and Anne Arundel counties. In Calvert County, numerous shoreline homes between 2 and 4 feet above sea level were flooded. Hundreds of large trees were downed onto roads, homes, and power lines. Over 11,000 electrical outages were reported. Winds gusted to 69 mph at Mid Bay buoy offshore of Calvert Cliffs. A wind survey showed ribbons of tree damage from microburst winds estimated between 70 and 80 mph.
- September 18, 2003 – Tropical Storm Isabel’s eye tracked west of the bay, but the storm's 40 to 50 mph sustained winds pushed a bulge of water northward up the bay and its tributaries producing a record storm surge. The Maryland western shore counties, including Calvert County experienced a record storm surge reaching 5 to 9 feet above normal tides. In many locations, Isabel's surge was higher than the previous record storm, the Chesapeake-Potomac Hurricane of 1933. Coastal properties below 10 feet mean sea level (msl) exposed to wave action, were severely damaged. Over 2,000 people were evacuated from their homes. Maryland saw 472 homes and buildings destroyed, 3,260 with major damage and over 3,600 more affected. Extensive damage occurred to Maryland's shoreline which rarely sees storms of this intensity. In Calvert County, 4 to 5 foot waves crashed into the towns of North Beach, Chesapeake

Beach and Solomons. In North Beach, a house was moved off its foundation. Both the piers at North Beach and Solomons Island were lost with the storm surge causing extensive damage to the shoreline. In Chesapeake Beach, Stinnett's Restaurant and a house on 28th Street were severely damaged and had to be condemned. Hurricane Isabel's wind field extended for hundreds of miles from the storm's center. Calvert County had 22,400 customers without power. While most people had their power back in a week, some locations took up to 2 weeks.

Probability

In order to estimate the frequency of occurrence, the number of hurricanes is compared to the length of the period of record, which is from 1900-2010 and is 110 years. The recurrence interval is defined from this information and is a rough estimate of the amount of time, on average, during which one occurrence of a storm will take place. It is important to note that storms can occur multiple times during one recurrence interval. The overall recurrence interval for Hurricanes/Tropical Storms tracking within 65 miles of Calvert County is 2.9 years. Recurrence intervals for hurricanes and tropical storms within and in the vicinity of Calvert County are presented in Table 19.

**Table 19: Estimated Recurrence Intervals of Hurricanes and Tropical Storms within 65 miles of Calvert County (1900-2010)**

| Storm Type | Number of Occurrences With Center of Storm Track Within 65 miles of Calvert County | Recurrence Interval (years) |
|---|---|---|
| Tropical Depression/Extra Tropical | 21 | 5.2 |
| Tropical Storm | 16 | 6.9 |
| Category 1 | no record | |
| Category 2 | no record | |
| Category 3 | no record | |
| Category 4 | no record | |
| Category 5 | no record | |
| Tropical Storms and All Hurricanes | 37 | 2.9 |

Another source of hurricane frequency prediction is the Forecast of Atlantic Seasonal Hurricane Activity, which is performed annually by the members of the Colorado State University Hurricane Forecast Team, including Dr. William Gray. The forecasts include individual monthly predictions activity and seasonal and monthly U.S. hurricane landfall probabilities. The prediction varies annually based on several atmospheric and oceanic factors and is available through the team's website at *http://hurricane.atmos.colostate.edu/forecasts/*

All of Calvert County can be affected by a hurricane or a tropical storm. Since the storms can disrupt power and inundate roads, they can cause havoc on the entire community. The county's proximity to the Chesapeake Bay exposes it to significant storm surge with considerable potential for flooding, coastal erosion, and storm surge.

### *Landslide*

Overview

Landslides include a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over-steepened slope is the primary reason for a landslide, there are other contributing factors:

- erosion by rivers, or ocean waves creates over-steepened slopes;
- rock and soil slopes are weakened through saturation by snowmelt or heavy rains;
- earthquakes create stresses that make weak slopes fail;
- earthquakes of magnitude 4.0 and greater have been known to trigger landslides; or,
- excess weight from accumulation of rain or snow, stockpiling of rock or ore, waste piles, or from man-made structures may stress weak slopes to failure.

Slope material that becomes saturated with water may develop a debris flow or mud flow. The resulting slurry of rock and mud may pick up trees, houses, and cars, thus blocking bridges and tributaries causing flooding along its path.

Landslides are often prompted by the occurrence of other disasters. Floods or long duration precipitation events create saturated, unstable soils that are more susceptible to failure. The forces of earthquakes can also cause landslides.

History

Landslides constitute a major geologic hazard because they are widespread, occurring in all 50 states, and cause $1 to 2 billion in damages and more than 25 fatalities on average each year. Landslides pose serious threats to highways and structures that support fisheries, tourism, timber harvesting, mining, and energy production as well as general transportation. Landslides commonly occur with other major natural disasters such as earthquakes and floods that exacerbate relief and reconstruction efforts. Expanded development and other land use have increased the incidence of landslide disasters.

Most landslide events in Maryland tend to be human-induced. Cut and fill slopes for roadways, septic fields on sloped areas, seeps from detention areas/reservoirs, and clearing of vegetation in sloped areas. Within Calvert County, the potential for landslides exists for steep roadways cut along the Chesapeake Bay.

Calvert County has had a few incidents of landslides along the Chesapeake Bay that were tied to other hazard events such as shoreline erosion, hurricanes, and droughts. Severe storms, flash floods, and coastal storms can cause the ground to become saturated with water and cause the land to slide or erode down the embankment. Drought can cause a landslide when the vegetation on cliffs dries out or develops shallow root systems as plants' roots grow closer to the surface seeking water. This increases the chance of the land sliding from even a normal rain event.

Based on the Landslide Susceptibility map from the USGS (Figure 8) much of Calvert County has a low incidence of landslides, meaning that less the 1.5% of the area is involved. However, there are pockets of land in Calvert County, especially where the cliffs are high above the Chesapeake Bay that has a high susceptibility to landslides,

combined with a low incident rate. This area was covered in more detail under the shoreline erosion hazard.

Given the relatively flat relief of Calvert County, and the low landslide incidence as mapped by the USGS, landslides are not considered a significant threat within the county as a whole, other than on the coastal areas where there is a moderate probability of landslides. The Planning Team considers the overall probability, for both the County and the towns, to be low.

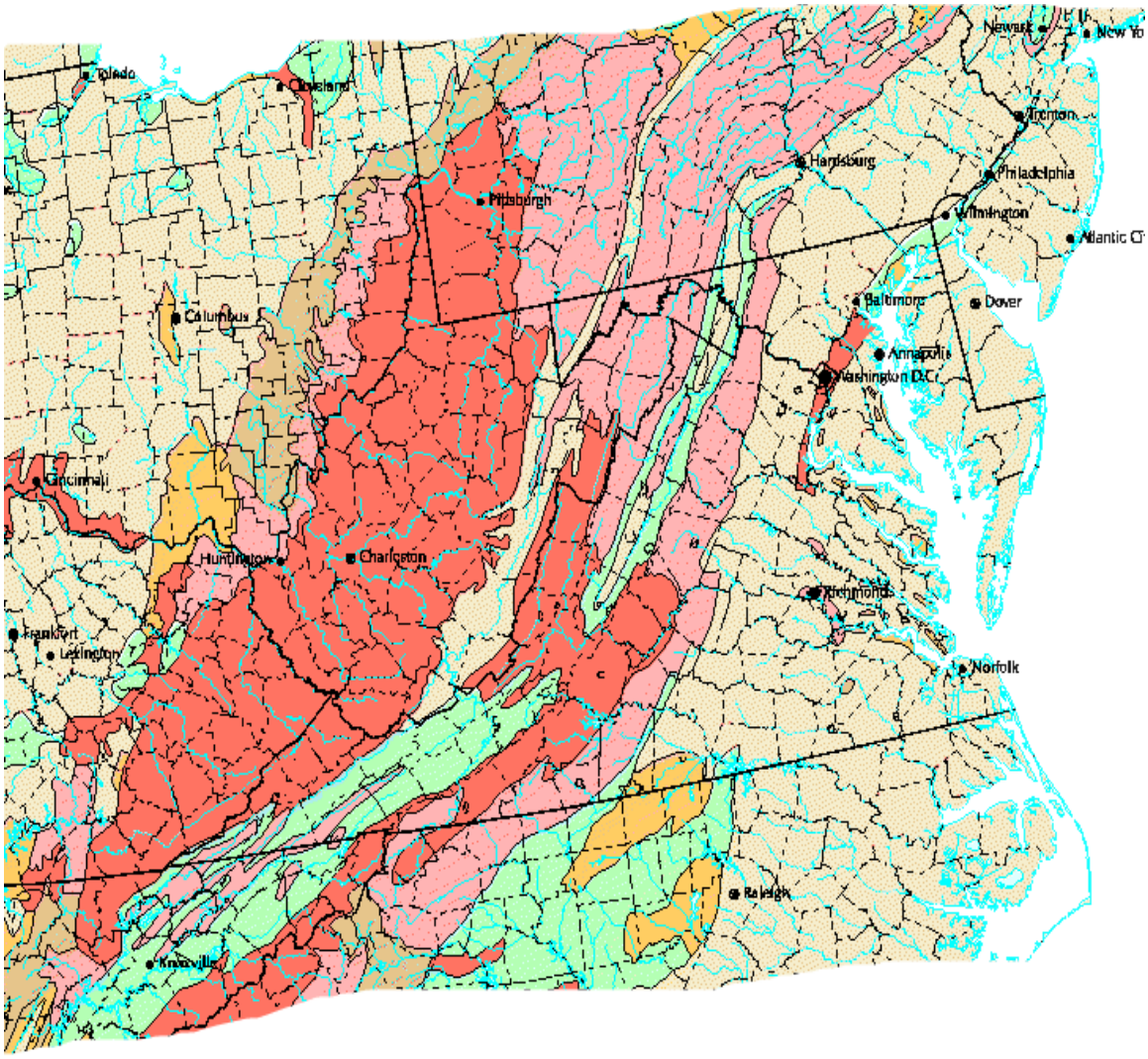


**Figure 8: Landslide Susceptibility**

*http://landslides.usgs.gov/html_files/landslides/nationalmap/ecentral.html*

### *Land Subsidence*

Overview

Land subsidence is the downward movement of the earth's crust. The rate of sea level rise in a coastal area such as Calvert County is relative to the land adjacent to the sea. Southern Maryland is experiencing both regional subsidence (along the east coast of the United States) and sea level rise, exacerbating the effects of storms.

Measurement of sea level at any particular location is relative. Relative sea level rise is the sum of global (eustatic) sea level change plus changes in vertical land movement at a particular location due to tectonic (e.g. faulting), neotectonic (e.g., glacio-isostatic readjustment, postglacial rebound) and anthropogenic impacts (e.g., subsidence due to groundwater extraction).

The current rate of sea level rise along Maryland's coastline is nearly twice that of the global average, a result probably due to substantial land subsidence and glacio-isostatic readjustment. Data gathered from tide gauges, however, do not provide an accurate measure of whether the sea level is rising or the land is sinking. To calculate relative sea level rise, tide gauge data must be correlated with data on vertical land movement (e.g., land subsidence).

History

Land subsidence is usually not observable in the short-term because it occurs over a large area over a long period of time. However, NOAA has compiled data from regional tide gauges to document the rates of sea level rise, which are believed to include land subsidence in the region. At Solomons Island in Calvert County, the local NOAA tide station, the mean sea level trend is 3.41 millimeters/year with a 95% confidence interval of +/- 0.29 mm per year, based on monthly mean sea level data from 1937 to 2006 (Figure 9). This rate is equivalent to a change of 1.12 feet in 100 years. Figure 9 shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95 percent confidence interval.

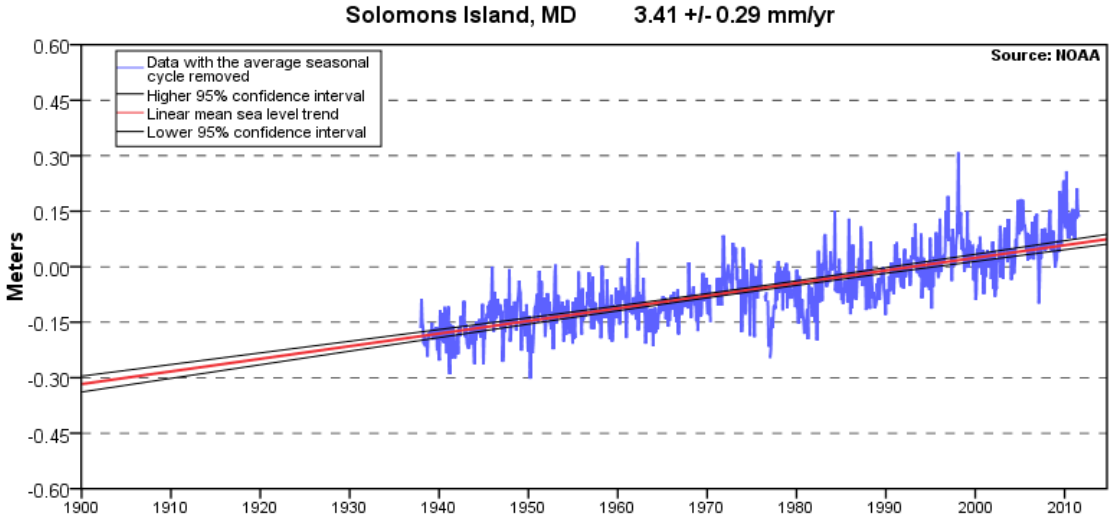


**Figure 9: Sea Level Trend**

Researchers generally agree that the primary impacts of sea level rise and land subsidence include coastal flooding, coastal erosion, wetland inundation, and salt water

intrusion. Calvert County's coastline, made up of the varied landscapes of the Chesapeake Bay, coastal tributaries, and tidal wetlands, is highly susceptible to all such impacts. The magnitude of impacts will vary across the County and towns according to physical site characteristics. Geology, topography, bathymetry, fetch, surface/ground water condition, man-made features, and the frequency and intensity of extreme events, all affect the degree of impact over time at a given location. As a causal force, sea level rise and land subsidence influence on-going coastal processes, thereby increasing the vulnerability of coastal areas already under natural and human-induced stress. While the County will be subject to the full range of impacts, risks associated with shoreline erosion, inundation, and coastal flooding pose the most significant threat.

Probability

Based on the current history of land subsidence in Calvert County, the probability of occurrence is low. However, scientists believe that land subsidence is a contributing factor to the high rate of sea level rise in Maryland and that the probability of future land subsidence occurring in Calvert County may be high. While the rate of sea level rise may already be increasing, there are not enough data to suggest a corresponding increase or decrease in land subsidence.

### *Severe Storm*

Overview

Severe storms include thunderstorms, lightning, hailstorms, winter storms and nor'easters. Thunderstorms are forms of convection produced when warm moist air is overrun by dry cool air. As the warm air rises, thunderhead clouds (cumulonimbus) form and can cause the strong winds, lightning, thunder, hail and rain associated with these storms. Instability can be caused by surface heating or upper-tropospheric (~50,000 feet) divergence of air (rising air parcels can also result from airflows over mountainous areas). Generally, the former "air mass" thunderstorms form on warm-season afternoons and are not severe. The latter "dynamically-driven" thunderstorms generally form in association with a cold front or other regional-scaled atmospheric disturbance. These storms can become severe, producing strong winds, frequent lightning, hail, downbursts and even tornadoes.

Every thunderstorm produces lightning, which kills more people each year than tornadoes. Heavy rain from thunderstorms can lead to flash flooding. Of the estimated 100,000 thunderstorms that occur each year in the U.S., only about 10% are classified as severe. A thunderstorm is considered to be severe if it produces hail at least 1.0 inches in diameter, wind speeds of 58 mph or higher, or tornadoes. Hailstorms are an outgrowth of severe thunderstorms and cause nearly $1 billion in damage to property and crops on an annual basis in the U.S. Typical thunderstorms can be three miles wide at the base, rise to 40,000–60,000 feet in the troposphere, and contain half a million tons of condensed water.

Lightning is defined as a sudden and violent discharge of electricity from within a thunderstorm due to a difference in electrical charges, and represents a flow of electrical current from cloud-to-cloud or cloud-to-ground. Nationally, lightning causes extensive damage to buildings and structures, kills or injures people and livestock, starts forest fires and wildfires and disrupts electromagnetic transmissions. Lightning is extremely dangerous during dry lightning storms because people remain outside due to the lack of precipitation.

At any given time, there are nearly 2,000 thunderstorms in progress over the earth's surface. There are at least 100,000 thunderstorms annually across the United States.

To the general public, lightning is often perceived as a minor hazard. However, lightning-caused damage, injuries and deaths establish lightning as a significant hazard associated with any thunderstorm in any area of the State.

Damage from lightning occurs four ways: (1) electrocution/severe shock of humans and animals; (2) vaporization of materials along the path of the lightning strike; (3) fire caused by the high temperatures associated with lightning (10,000-60,000°F); and (4) the sudden power surge that can damage electrical/electronic equipment. Large outdoor gatherings (sporting events, concerts, campgrounds, etc.) are particularly vulnerable to lightning strikes that could result in injuries and deaths.

Hailstorms are violent and spectacular phenomena of atmospheric convection, always associated with heavy rain, gusty winds, thunderstorm, and lightning. Hail is a product of strong convection and occurs only in connection with a thunderstorm where the high velocity updrafts carry large raindrops into the upper atmosphere (where the temperature is well below the freezing point of water).

Hail stones grow in size when the frozen droplet is repeatedly blown into the higher elevations. The hailstone ascends as long as the updraft velocity is high enough to hold the hailstone. As soon the size and weight of the hailstone overcomes the lifting capacity of updraft, it begins to fall freely under the influence of gravity. The falling of hail stones, under thunderstorm conditions, is accompanied by a cold downdraft of air.

Winter storms can vary in size and strength and include heavy snowstorms, blizzards, freezing rain, sleet, ice storms and blowing and drifting snow conditions. Extremely cold temperatures accompanied by strong winds can result in wind chills that cause bodily injury such as frostbite and death.

A variety of weather phenomena and conditions can occur during winter storms. For clarification, the following are NWS-approved descriptions of winter storm elements:

- **Heavy snowfall** – the accumulation of six or more inches of snow in a 12-hour period or eight or more inches in a 24-hour period.
- **Blizzard** – the occurrence of sustained wind speeds in excess of 35 miles per hour accompanied by heavy snowfall or large amounts of blowing or drifting snow.
- **Ice storm** – an occurrence where rain falls from warmer upper layers of the atmosphere to the colder ground, freezing upon contact with the ground and exposed objects near the ground.
- **Freezing drizzle/freezing rain** – the effect of drizzle or rain freezing upon impact on objects that have a temperature of 32 degrees Fahrenheit or below.
- **Sleet** – solid grains or pellets of ice formed by the freezing of raindrops or the refreezing of largely melted snowflakes. This ice does not cling to surfaces.
- **Wind chill** – an apparent temperature that describes the combined effect of wind and low air temperatures on exposed skin.

Nor’easters are extra-tropical events that produce strong winds and precipitation in the form of heavy rain, ice or snow. They can cause increases in tidal elevations (storm surge), wind speed, and erosion. These cyclonic storms, called nor’easters because of

the direction of the storm winds, can last for several days and can impact very large areas. The presence of the Gulf Stream off the eastern seaboard in the winter season acts to dramatically enhance the surface horizontal temperature gradients within the coastal zone.

For Nor'easters to occur in Maryland, an arctic air mass should be in place. While high pressure builds over New England, cold arctic air flows south from the high pressure area. The dense cold air is unable to move west over the Appalachian Mountains, so it funnels south down the valleys and along the Coastal Plain. Winds around the Nor'easter's center can become intense. The strong northeast winds that rack the coast and inland areas give the storm its name. The wind builds large waves that batter the coastline and sometimes pile water inland causing major coastal flooding and severe beach erosion. Unlike hurricanes, which usually come and go within one tide cycle, a nor'easter can linger through several tides, each one piling more and more water onshore, into the bays and creeks, and dragging more sand away from the beaches. Storm surge is a major component of nor'easter storms along the East Coast of the U.S. Because winds are moving from a north and/or eastward position, winds move across the ocean towards shore and form large waves.

A classification system for Extratropical Storms and Nor'easters, show in Table 20 was developed by Halsey and later modified by Dolan and Davis, but is not yet as widely accepted as the Saffir-Simpson hurricane classification. The Dolan-Davis classification defines five storm classes and uses deepwater significant wave height and duration to define storm power and categorize likely storm impacts (e.g., beach and dune erosion, dune breaching, and property damage).

**Table 20: Dolan-Davis Nor'easter Storm Scale**

| Storm Class | Beach Erosion | Beach Recovery | Dune Erosion | Dune Breaching | Property Damage |
|---|---|---|---|---|---|
| Class 1 (weak) | Minor changes | Full and usually immediate | None | No | No |
| Class 2 (moderate) | Modest: confined to lower beach | Full | None | No | Minor, local |
| Class 3 (significant) | Erosion: extends across entire beach | Usually recovery over considerable period of time (months) | Can be significant | No | Loss of many structures at local scale |
| Class 4 (severe) | Severe beach erosion and recession | Recovery seldom total | Severe dune erosion or destruction | Where beach is narrow | Losses of structures at community level |
| Class 5 (extreme) | Extreme beach erosion (up to 50 meters in places) | Permanent and clearly noticeable changes | Dunes destroyed over extensive areas | Wide-spread | Extensive regional scale (millions of dollars) |

*Source: Dolan and Davis, 1992*

Historic Activity

Records with the NWS indicate that, since 1950, there have been 107 reported incidents of severe thunderstorms. The most damaging thunderstorm in Calvert County occurred in 1962, which resulted in wind gusts of 80 mph and over $300,000 in damages (1962

dollars). According to the National Climatic Data Center, 10 Lightning events have occurred in Calvert County, with the most damage coming during events in the Dunkirk area in June 2000 ($100,000) and again in September 2000 ($110,000). There have also been 19 documented Hail events according to the National Climatic Data Center. The most damage sustained from Hail in Calvert County occurred around St Leonard in 1998 ($3000).

There have been 51 winter storm events including 4 which received Major Disaster Declarations: March 1994, January 1996, April 2000, and May 2010 and 2 that received Emergency Declarations: March 1993 and March 2003.

The blizzard of February 1979 resulted in over $2 million in property damages in Calvert County. Back-to-back ice storms in 1994 resulted in 35 injuries and $500,000 in property damage in Calvert County alone, when 3 to 5 inches of ice accumulated on surfaces. The Southern Maryland area was one of the hardest hit, where an estimated 10% of the trees were lost. Trees fell on cars, houses, phone and power lines and made roads impassable. Electric and phone lines were down with as much as 90% of the people were without power, some up to a week. There were hundreds of injuries from automobile accidents and people falling on ice. The 1996 blizzard had 11 reported injuries and approximately $12,000 in property damage. The April of 2000 storm dumped over 18 inches of snow in Calvert County and tied up transportation routes and the February 15-18, 2003 storm caused major damage, injured 10 people and resulted in over $5.2 million dollars in property damage statewide.

Table 21 discusses the nor'easters that hit various parts of Maryland since 1950.

**Table 21: Nor'easter History**

| Date/Duration | Type of Storm | Impact | Comments |
|---|---|---|---|
| Nov 6&7, 1953 | Slow moving Nor'easter | Winds at 30 mph caused major drifting, closing down highways. | Eastern shore counties saw 10-12 inches of snow. |
| Feb 15-17, 1958 | Severe Nor'easter | Winds 25-35 mph created blizzard conditions & subzero windchills. | Eastern shore counties saw 10-16 inches of snow. Damage estimated at $500 million in Maryland, Delaware, and DC. |
| Mar 19-21, 1958 | Slow moving Nor'easter | Over one foot of snow. Thousands of homes without heat, light, power, and telephone service. | Damage was $10 million in Maryland and 8 deaths in the state attributed to the storm. |
| Dec 11&12, 1960 | Snowstorm | Winds over 50 mph created blizzard conditions & heavy drifting of snow. | Eight deaths reported in Maryland. Damage in Maryland up to $10 million. |
| Mar 5-9, 1962 | Intense Nor'easter | Winds up to 70 mph. Ocean City, Maryland sustained major damage. | Eastern shore counties experienced mixed precipitation. |
| Feb 6, 1978 | Intense Nor'easter | Brought 18 inches of snow to northern Maryland. | |
| Dec 10-12, 1992 | Intense Nor'easter | Storm caused flooding in Ocean City and heavy rain over the Chesapeake Bay. | Western Maryland was hit with 2-3 feet of snow. |
| Mar 13-14, 1993 | Intense Nor'easter | The "Perfect Storm" brought coastal flooding and blizzard like conditions | Western Maryland saw 1.5-2.5 feet of snow and Baltimore recorded its lowest barometric pressure ever (28.51 in.) |

| Date/Duration | Type of Storm | Impact | Comments |
|---|---|---|---|
| Jan 25, 2000 | Intense Nor'easter | Brought 1-1.5 feet of snow to the Chesapeake Bay Counties | |
| February 14, 2003 | Snowstorm | Brought between 7-12 inches of sleet accumulation | 28.2 inches of snow was recorded at Baltimore-Washington Airport |
| February 11, 2006 | Snowstorm | Snow accumulations between 8-14 inches occurred in the Chesapeake Bay Area | |
| 12/18/2009 | Winter Storm | 14-17 inches of snow fell across the western portion of the county | |

*Source: National Weather Service Forecast Office – Maryland Winters*

Probability

There is a high probability of severe storms, including thunderstorms, lightning strikes, damaging hail, severe winter storms and nor'easters (Table 22). These events can occur anywhere within in the county including the towns of Chesapeake Beach and North Beach. Thunderstorms can cause flooding, property damage, and disruption of utility services such as power, telephones, or cable. Lightning strikes can cause death or injury, and ignite wildfires or structure fires. Severe winter storms and freezes can impact people, especially transient, low or fixed income, or elderly populations. Other impacts include hazardous conditions caused by falling trees and power lines, requirement of additional manpower to clear debris, snow removal and salting, and large scale use of public shelters, and traffic delays. Nor'easters can cause coastal flooding, high winds and property damage.

**Table 22: Estimated Recurrence Intervals of Severe Storms**

| Storm Event | Number of Occurrences Within Calvert County | Recurrence Interval (years) |
|---|---|---|
| Thunderstorms | 108 | 0.53 |
| Hail | 19 | 3 |
| Lightning | 10 | 5.8 |
| Winter Storms | 51 | 1.1 |
| All Events | 188 | 0.31 |

The rate of occurrence for these events in Calvert County is one event every 0.31 years, which is a very high rate of occurrence.

### *Tornado*

Overview

A tornado is a relatively short-lived storm composed of an intense rotating column of air, extending from a thunderstorm cloud system. Average winds in a tornado, although never accurately measured, are thought to range between 100 and 200 mph, but some may have winds exceeding 300 mph. The following are NWS definitions of a tornado and associated terms:

- **Tornado** – A violently rotating column of air that is touching the ground.
- **Funnel cloud** – A rapidly rotating column of air that does not touch the ground.

- **Downburst** – A strong downdraft, initiated by a thunderstorm, which induces an outburst of straight-line winds on or near the ground. They may last anywhere from a few minutes in small-scale microbursts to periods of up to 20 minutes in larger, longer macro-bursts. Wind speeds in downbursts can reach 150 mph and therefore can result in damages similar to tornado damages.

Tornadoes are classified by the degree of damage they cause. A commonly used tornado classification is called the Enhanced Fujita Scale and is shown in Table 23.

**Table 23: Tornado Damage Scale**

| Scale | Wind Speeds | Damage |
|---|---|---|
| EF0 | 65 to 85 MPH | Minor or no damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. |
| EF1 | 86 to 110 MPH | Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken. |
| EF2 | 111 to 135 MPH | Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground. |
| EF3 | 136 to 165 MPH | Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown. |
| EF4 | 166 to 200 MPH | Extreme damage. Well-constructed and whole frame houses completely leveled; cars and other large objects thrown and small missiles generated. |
| EF5 | >200 | Total Destruction. Strong framed, well built houses leveled off foundations and swept away; steel-reinforced concrete structures are critically damaged; tall building collapse. |

Nearly 70% of the deaths from tornadoes happen to people located in residential structures. Of these, over 40% are located in mobile homes, which are easily overturned and destroyed due to the low wind resistance of the structures. Table 24 breaks down the tornado deaths in the United States based on location or other circumstances.

**Table 24: United States Tornado Deaths by Location/Circumstances, 1985-2003**

| Year | Mobile Home | Permanent Home | Vehicle | Business | School or Church | Outdoors | Unknown | Total |
|---|---|---|---|---|---|---|---|---|
| 2003 | 25 | 24 | 0 | 1 | 0 | 3 | 1 | 54 |
| 2002 | 32 | 15 | 4 | 0 | 1 | 3 | 0 | 55 |
| 2001 | 17 | 15 | 3 | 3 | 0 | 2 | 0 | 40 |
| 2000 | 28 | 7 | 4 | 0 | 0 | 2 | 0 | 41 |
| 1999 | 39 | 35 | 6 | 8 | 0 | 6 | 1 | 95 |
| 1998 | 65 | 40 | 15 | 7 | 0 | 3 | 0 | 130 |
| 1997 | 30 | 23 | 3 | 3 | 0 | 7 | 1 | 67 |
| 1996 | 14 | 8 | 2 | 0 | 0 | 0 | 1 | 25 |
| 1995 | 8 | 15 | 4 | 0 | 0 | 3 | 0 | 30 |
| 1994 | 26 | 14 | 3 | 0 | 20 | 6 | 0 | 69 |
| 1993 | 13 | 6 | 7 | 3 | 1 | 3 | 0 | 33 |
| 1992 | 20 | 18 | 0 | 0 | 0 | 1 | 0 | 39 |
| 1991 | 20 | 3 | 4 | 0 | 0 | 12 | 0 | 39 |
| 1990 | 7 | 11 | 14 | 15 | 5 | 1 | 0 | 53 |

| Year | Mobile Home | Permanent Home | Vehicle | Business | School or Church | Outdoors | Unknown | Total |
|---|---|---|---|---|---|---|---|---|
| 1989 | 12 | 8 | 16 | 4 | 9 | 0 | 1 | 50 |
| 1988 | 21 | 6 | 3 | 2 | 0 | 0 | 0 | 32 |
| 1987 | 24 | 7 | 3 | 0 | 22 | 3 | 0 | 59 |
| 1986 | 7 | 3 | 3 | 0 | 0 | 0 | 2 | 15 |
| 1985 | 28 | 40 | 4 | 0 | 0 | 0 | 22 | 94 |
| Total | 436 | 298 | 98 | 46 | 58 | 55 | 29 | 1020 |
| Percent | 42.7% | 29.2% | 9.6% | 4.5% | 5.7% | 5.4% | 2.8% | 100.0% |

***http://www.spc.noaa.gov/climo/torn/locations.html***

A tornado path averages four miles, but may reach up to 300 miles in length. Widths average 300 to 400 yards, but severe tornadoes have cut swaths a mile or more in width, or have formed groups of two or three funnels traveling together. On the average, tornadoes move between 25 and 45 mph, but speeds over land of up to 70 mph have been reported. Tornadoes rarely last more than a couple of minutes over a spot or more than 15 to 20 minutes in a 10-mile area, but their short periods of existence do not limit their devastation of an area. The destructive power of the tornado results primarily from its high wind velocities and sudden changes in pressure. Damages from tornadoes result from extreme wind pressure and windborne debris. Since tornadoes are generally associated with severe storm systems, they are often accompanied by hail, torrential rain and intense lightning. Depending on their intensity, tornadoes can uproot trees, bring down power lines and destroy buildings. Flying debris is the main cause of serious injury and death.

Downbursts are characterized by straight-line winds and damages are localized, resembling that of tornadoes. There are significant interactions between tornadoes and downbursts and a tornado's path can also be affected by downbursts. Because of this, the path of a tornado can be very unpredictable, including veering right and left or even U-turning.

FEMA's publication, *Design and Construction Guidance for Community Shelters,* July 2000, presents a map of four wind zones in the U.S. (see Figure 10) and provides design wind speeds for shelters and other critical facilities. Zone IV shows the areas of highest wind activity which are situated in the Midwest and Tornado Alley, while Zone I shows the areas of lowest activity which are in the western U.S. Calvert County is classified as wind zone II with design wind speeds up to 180 mph and also within the hurricane susceptible region.

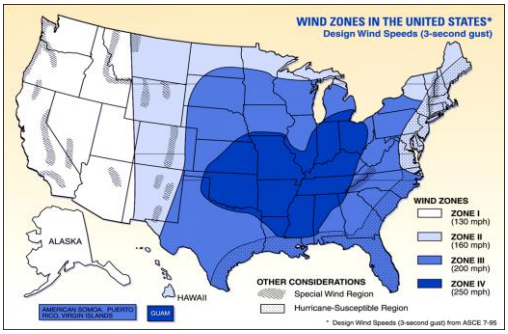


**Figure 10: Wind Zones in the U.S.**

Historic Activity

Calvert County reported 13 tornadoes from 1978 to 2010. Of these, the most devastating was the one in April 2002 when a massive tornadic storm tore through central Charles and Calvert Counties (see Figure 11). The tornadoes the storm produced left a 64 mile path of destruction, ranging from F1 to F4 damage. Five people were killed, 122 were injured, and over $115 million in damage was reported. The tornadoes were spawned from a super cell thunderstorm that crossed the Potomac River from Prince William County.

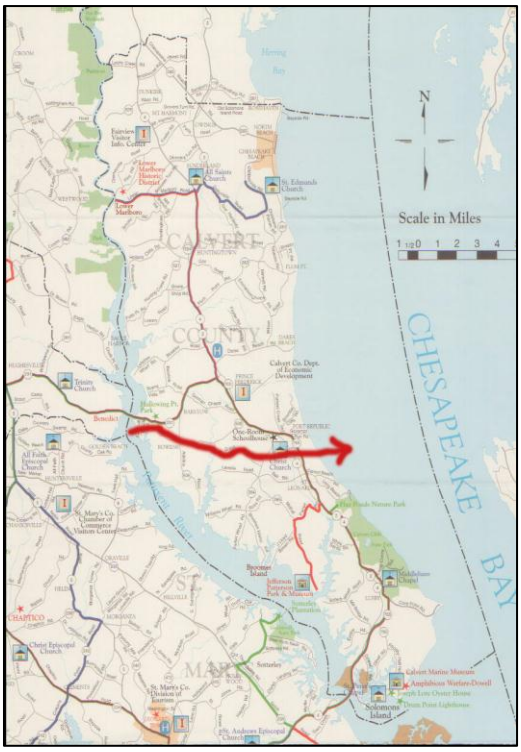


**Figure 11: April 2002 Tornado Path Update**

The tornado tracked south of Route 231 and weakened to F2 strength before crossing the Patuxent River into Calvert County just south of the bridge. In Calvert County, the tornado first struck the community of Patuxent View just south of Route 231 at F2 strength. Over half of the homes in this development were damaged. One home with no foundation or anchoring just east of Patuxent View off Hallowing Point Road was picked up and thrown 80 feet into a culvert. A 68-year-old man and his 65-year-old wife who were taking shelter in the house were killed. The tornado continued eastward along Sixes Road to the intersection of Adelina Road. Several homes and barns were damaged. From there it pushed east through the communities of Boyds Farm, Mutual Estates, and Chippingwood, where it damaged more property. It crossed Route 2/4 and 765 just north of St. Leonard, downing trees as it went. Finally, it crossed the Western Shores at F1 strength before it moved offshore. Another tornado formed on the Long Beach shoreline just north of Calvert Cliffs Power Plant. It downed trees before moving offshore. Across the county, 125 homes were damaged and 10 were destroyed, mainly in the Prince Frederick and Hallowing Point areas. County officials collected over 300 tons of downed trees and storm debris.

Other tornadoes in Calvert County include the following:

- June 27, 1978 an F2 tornado struck from near Dunkirk to Chaneyville to Huntingtown. The damage path was 6.9 miles long and an average of 50 yards wide. There were no fatalities, but 3 people were injured. One person was hurt when a tree fell on their car. Another was injured by flying glass and another when a mobile home turned over. Four barns and an equipment shed were destroyed and a swath was cut through a corn field. Damages are estimated at $150,000.
- September 5, 1979 an F1 tornado spawned from the remnants of Hurricane David struck between Drum Point and Olivet. The damage path was 0.5 miles long and an average of 30 yards wide. There were no fatalities, but one person

was injured from flying debris when the tornado removed a roof off of his beach front house, buckled walls and took away brick siding. Large trees were uprooted and snapped and tobacco barns were destroyed. Damages are estimated at $100,000.

- October 13, 1983 an F2 tornado moved across the Patuxent River from St. Mary's County to Broomes Island. The damage path was 1 mile long and 110 yards wide. There were no fatalities or injuries. It demolished a cinderblock fish house, damaged homes, uprooted and snapped trees and took down utility lines. Damages are estimated at $40,000.
- May 8, 1984 an F0 waterspout/tornado was observed hitting Broomes Island. The damage path on land was 0.25 miles long and about 20 yards wide. This was one of several tornadoes in Maryland on this day. There were no fatalities or injuries. The tornado did about $15,000 damage to one river front residence and did some more damage nearby. Total damages are estimated at $20,000.
- July 27, 1994 an F1 tornado struck near Dunkirk. The damage path was 3 miles long and 120 yards wide. This was one of an outbreak of tornadoes that swept from central Virginia across southern Maryland northeast into southeastern Pennsylvania. There were no fatalities or injuries with this tornado. The tornado destroyed a couple barns and did minor damage to some homes. It uprooted and snapped many trees. Total damages were estimated at $120,000.
- August 17, 1994 an F0 tornado was sighted near Sunderland. Damage was only to some trees. Damages are estimated at $1,000 or less.
- July 13, 1996 an F1 tornado struck 2 miles northwest of Dunkirk. The damage path was 1.2 miles long and 50 yards wide. The tornado was spawned by the remnants of Hurricane Bertha. There were no fatalities or injuries. It demolished a chimney and a roof on a farm house. Numerous trees were snapped and uprooted. Two homes had minor damage. Damages were estimated at $120,000.
- April 21, 2000 an F1 tornado struck just southeast of Dunkirk. The damage path was 1.5 miles long and about 75 yards wide. There were no fatalities or injuries. A school, two cars and two barns were damaged along with trees. Total damages were estimated at $210,000.
- May 13, 2000 an F1 tornado crossed into Calvert County from Prince Georges County hitting an area north of Dunkirk. One tree fell on a car driving south on Route 4. The tornado continued east to Chaney and dissipated. Most of the damage was to trees. The damage path was 4 miles long and about 150 yards wide. There were no fatalities and only 1 injury. The tornado did about $20,000 damage.
- May 22, 2001 an F0 tornado/waterspout was observed by several people moving across the southern tip of Solomons Island and the Patuxent River. There was no damage to property and no injuries. The storm path was estimated at 1 mile long and about 50 yards wide.
- April 28, 2002 an F2 tornado struck 2 Miles West of Bowens. A strong tornado crossed the Patuxent River from Charles County and moved east through central Calvert County. It tracked between Patuxent View and the Western Shores before moving onto the Chesapeake Bay.

- April 28, 2002, an F1 tornado (part of the same storm system as previous tornado) struck 5 miles east south east of Long Beach. A tornado developed on the Long Beach shoreline just north of Calvert Cliffs power plant and moved offshore.
- June 4, 2008, an EF-0 tornado with sustained wind as high as 85 mph plowed through Chesapeake Beach on its way across the bay. The twister cut a swath 75 yards wide and about 1.5 miles long. At least five people sustained injuries, none life threatening, during the storm.

*http://www.erh.noaa.gov/er/lwx/Historic_Events/MDcnty-tornado-events.htm*

Probability

While the magnitude and location of tornadoes are unpredictable, most of those that occurred in Calvert County over the past 30 years have been classified as low intensity (EF0 and EF1). Tornadoes can occur anywhere within the county; however, manufactured homes are most vulnerable to tornado winds. In order to estimate the frequency of occurrence, the number of tornado days (not actual tornado incidents since tornadoes that occurred close in time on the same day are likely the same tornado that has re-formed, or a tornado that is part of the same system) is compared to the length of the period of record which is from 1978 to 2010. The recurrence interval is defined from this information and is an estimate of the amount of time, on average, during which one occurrence of a given category of tornado will take place. It is important to note that in reality, a tornado can occur multiple times during one recurrence interval, and that the recurrence interval is only an estimated average time period. Recurrence intervals for tornadoes within Calvert County are presented in Table 25.

**Table 25: Estimated Recurrence Intervals of Tornadoes (based on data from 1978 to 2010)**

| Tornado Class | Number of Occurrences Within Calvert County (Tornado Days) | Recurrence Interval (years) |
|---|---|---|
| F0 | 5 | 6.4 |
| F1 | 5 | 6.4 |
| F2 | 3 | 10.7 |
| F3 | no record | – |
| F4 | no record | – |
| F5 | no record | – |
| All Tornado Events | 13 | 2.5 |

There is a high rate of occurrence of tornadoes in Calvert County, with 1 occurring on average every 2.5 years; however the majority of tornados were classified as F0/F1. The damaging storms of 2002 increased the recurrence interval of severe storms (F2 or greater) to one incident every 10.5 years.

### *Tsunami*

Overview

Tsunamis are sea waves created by underwater earthquakes. When a tsunami is generated and makes its way to the shoreline, it can cause extensive damage to nearby structures and infrastructure, as well as significant inland flooding. Tsunamis generally

occur in the Pacific Ocean, but there have been some recorded events of tsunamis in the Caribbean area of the Atlantic Ocean.

Tsunamis are not generally considered a threat along the eastern seaboard of the continental U.S. The National Oceanic and Atmospheric Administration (NOAA) prepared a Tsunami Mitigation Plan for the Senate Appropriations Committee in the Fall of 1995 that included an area of mapped tsunami risk. This area did not include the eastern U.S. and only showed the tsunami risk area to include coastlines along Alaska, California, Hawaii, Oregon, and Washington.

Recent findings have indicated that tsunamis can occur along coastal Virginia and North Carolina. In coming years, tsunami scenarios for these portions of the Atlantic Coast will be further studied. However, the Maryland coast is not currently included as part of this potential risk area.

History

There is no history of Tsunamis in Calvert County.

Probability

Tsunamis are not considered a threat within the county and there is a very low probability of future tsunamis.

### *Wildfires*

Overview

A wildfire is an uncontrolled fire spreading through vegetative fuels, such as brush, marshes, grasslands or field lands, exposing and possibly consuming structures. Wildfires often begin unnoticed and spread quickly and are usually signaled by dense smoke that fills the area for miles around. The causes of these fires include lightning, human carelessness and arson. An urban interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels. Fires can be rated based on their fire danger rating (Table 26) which indicates the predominant fuel types and their capacity to ignite and burn.

**Table 26: Fire Danger Rating Descriptions**

| Rating | Description |
|---|---|
| Low | Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely for a few hours after rain, but wood fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting. |
| Moderate | Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy. |
| High | All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small. |
| Very High | Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels. |

Wildfires can occur at any time of day and during any month of the year, and the season length and peak months may vary appreciably from year to year. Land use, vegetation, amount of combustible materials present and weather conditions such as wind, low humidity and lack of precipitation are the chief factors determining the number of fires and acreage burned. Generally, fires are more likely when vegetation is dry from a winter with little snow and/or a spring and summer with sparse rainfall. Forest fires and wildfires are capable of causing significant injury, death and damage to property. The potential for property damage from fire increases each year as more recreational properties are developed on wooded land and increased numbers of people use these area. Fires can extensively impact the economy of an affected area, especially the logging, recreation and tourism industries, upon which many counties depend. Major direct costs associated with forest fires or wildfires are the salvage and removal of downed timber and debris and the restoration of the burned area. If burned-out woodlands and grasslands are not replanted quickly to prevent widespread soil erosion, then landslides, mudflows and floods could result, compounding the damage.

Historic Activity

Each year the Maryland Forest Service responds to an average of 660 wildfires, burning 3,600 acres across the state. Calvert County has not experienced any wildfire events in the past several years. The last wildfire events in the county date back to 1963 and were not considered major events. This can be partly attributed to the burning regulations and public education on preventing forest fires.

Probability

Forestland in Calvert County is predominantly composed of Coastal Plain – Beech/Oak Forest. The northern border of the county is composed of Red Oak – White Oak Forest. According to the Strategic Forest Land Assessment by the Maryland DNR, Calvert County's forested land has a high ecological value, but a low economic value, due to the unsuitability of the forestlands to timber harvest.

Figure 12 indicates that Calvert County had 55% of its land delineated as forested lands in 1999. Structures that are built in woody settings or adjacent to brushland are in the wildland/urban interface.

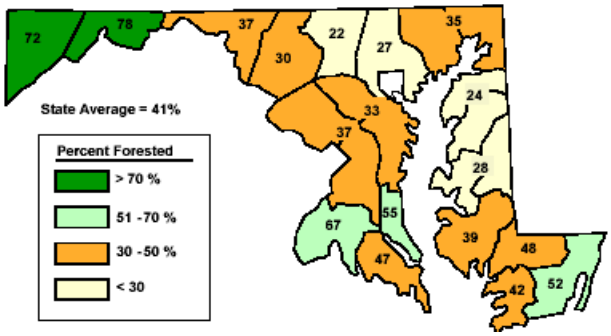


**Figure 12: Percent of Forested Land (1999)**

According to the DNR, the wildfire threat potential to the Calvert County forestlands is considered very high-to extreme (Figure 13) due to the pressures to convert large tracts of open land for development. While the Planning Team recognizes the value of this designation for assessing strategic forest lands, the group determined that the risk for hazard planning purposes is, in their opinion, low.

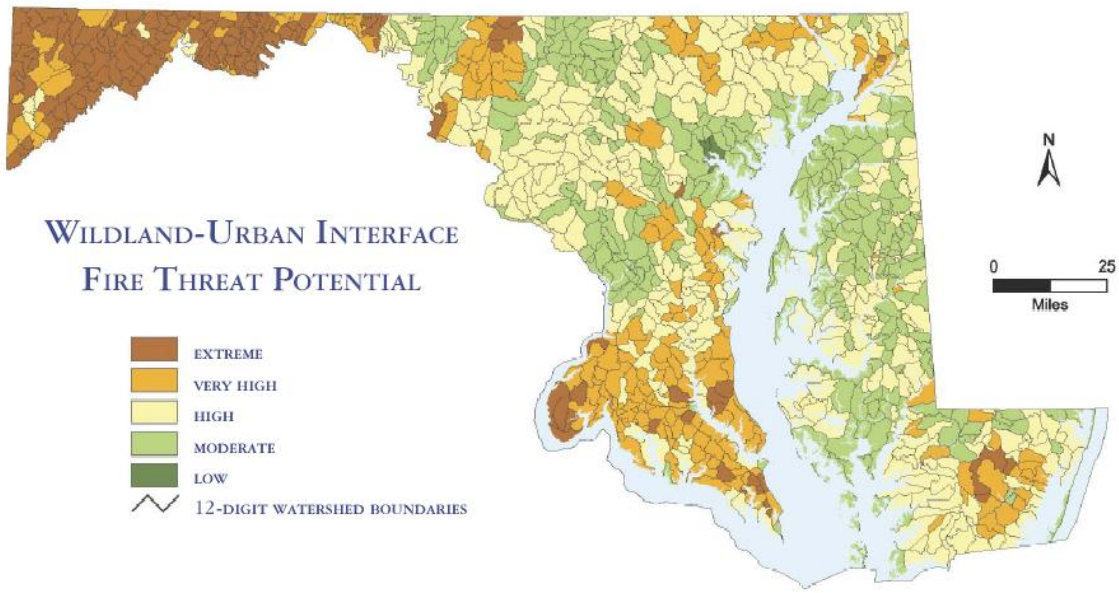


**Figure 13: Maryland Fire Threat Potential (2003)**

*http://www.dnr.state.md.us/forests/download/sfla_report.pdf*

The probability of wildfires in Calvert County is also tied to other hazards and may, therefore, be variable over time, including periods of prolonged drought when forests are more vulnerable to ignition from lightning strikes or human carelessness. Other contributing factors could include the buildup of dead underbrush from fallen trees and limbs following severe storms, tropical storms, ice storms, or tornadoes.

## Risk Assessment Summary

The Calvert County Risk Assessment reviewed 13 hazards including coastal/shoreline erosion, dam failure, drought, extreme summer heat, earthquake, flooding, hurricane/tropical storm, landslide, land subsidence, severe storm (including thunderstorm, hail, lightning, winter storms and nor'easters), tornado, tsunami, and wildfires. Based on the historical records, local input, and research from various State and Federal agencies, the Planning Team determined the frequency or probability of occurrence, for each of these hazards and assigned a risk rating of low, moderate, or high, as shown in Table 27.

**Table 27: Summary of Risk**

| Hazard | Number of Events | Years in Record | Frequency/ Probability | Risk |
|---|---|---|---|---|
| Coastal/Shoreline Erosion | Undetermined | 95 | – | High |
| Dam Failure | 0 | 44 | – | Low |
| Drought | 12 | 79 | 6.6 | Moderate |
| Extreme Summer Heat | 14 | 58 | 3.8 | Moderate |
| Earthquake<br>All of MD<br>Felt in Calvert | <br>47<br>14 | <br>250<br>250 | <br>5.2<br>17.5 | Moderate |
| Flooding | 22 | 60 | 2.7 | High |
| Hurricane/Tropical Storm<br>All<br>Category 1 and above | <br>37<br>0 | <br>110<br>110 | <br>2.9<br>0 | High |
| Landslide | 0 | 58 | – | Low |
| Land Subsidence | n/a | n/a | – | Low |
| Severe Storm<br>Thunderstorm<br>Hail<br>Lightning<br>Winter storms | <br>107<br>19<br>10<br>51 | <br>58<br>58<br>58<br>58 | <br>1.8<br>3<br>5.8<br>1.1 | High |
| Tornado<br>All<br>F0<br>F1<br>F2 | <br>13<br>5<br>5<br>3 | <br>32<br>32<br>32<br>32 | <br>2.5<br>6.4<br>6.4<br>10.7 | High |
| Tsunami | 0 | – | – | Low |
| Wildfires | 2 | 58 | 26.2 | Low |

Of the 13 hazards assessed, five were considered to be high risk in Calvert County. These included the following:

- Coastal/shoreline erosion due to the increasing number of structures that may be at risk in the next 10 to 25 years. This was identified as a major concern for the county after Hurricane Floyd and Tropical Storm Isabel.
- Historically floods have affected the county on average once every 2.7 years.
- Because scientists expect that land subsidence is already contributing to the high rate of sea level rise in Maryland, the probability of future land subsidence occurring in Calvert County is high.
- Hurricane/Tropical Storm based on the number of events that have passed with 65 miles of county in the past 110 years. The frequency of occurrence for all events was estimated at 1 event occurring every 2.9 years Severe storms because thunderstorms affect the county in some way each year. In addition, winter storms occur approximately every year
- Tornadoes because the county has experienced an average of 1 every 2.5 years, with a major tornado (F2 or above) occurring on average every 11 years.

Three hazards were assigned a risk rating of moderate. These included extreme summer heat, drought and earthquakes. The moderate rating indicated that a number of events have been documented in Calvert County, but their historic rate of occurrence placed them at a lower priority for the county than the hazards listed as high risk. The remaining five hazards: earthquakes; landslides; land subsidence; tsunamis; and wildfires were assigned a risk rating of low for Calvert County. The low rating indicated that either there were no documented events that have occurred in the county or in the case of earthquakes and wildfires, the documented events did not result in structural damages in the county. The low risk rating does not mean that these hazards cannot occur in the future nor does it mean that if a hazard occurred it would not result in any damages or injuries.

## 2010 Updates to Chapter 4

As part of the 2010 update to this plan, this section was updated to include any hazards that occurred during the planning period (2005-2010). The hazard frequencies were also updated as a result of the hazards that occurred.

# CHAPTER 5 – VULNERABILITY ASSESSMENT

## Overview

A Vulnerability Assessment is performed to determine the impact that hazards have on the built environment and how they can affect the safety of residents. The results of the Hazard Identification indicate that some of the hazards warrant a Vulnerability Assessment due to the frequency of occurrence of those hazards that have caused major damage in Calvert County. The Vulnerability Assessment uses the information generated in the hazard identification and hazard profile to identify locations in which residents of Calvert County could suffer the greatest injury or property damage in the event of a disaster. This assessment identifies the effects of hazard events by estimating the relative exposure of people, buildings, and infrastructure to hazardous conditions. Depending on the data available, a vulnerability assessment could involve counting the number of structures or people in the potential path of hazards or describing what these hazards can do to physical, social, and economic assets.

### ***Identification of Assets***

Asset identification is a critical step in the hazard mitigation planning process. Inventorying existing structures and identifying critical facilities provide insight into the county's vulnerability to select hazards and the magnitude of the potential damages of those hazards. Most risk assessment models examine the impact of various hazards on the built environment, including on the general building stock (residential, commercial, industrial, etc.); critical facilities; essential facilities; special facilities; and infrastructure and lifelines.

## General Building Stock

Calvert County parcel data was used to develop a detailed inventory of the built environment. Buildings were grouped into general occupancy classes such as residential, commercial, and industrial. FEMA's Hazards U.S. Multi-Hazard (HAZUS-MH) was also used as a tool to collate Census 2000 data about the basic building stock in Calvert County.

## Critical and Essential Facilities

Critical facilities are defined as those buildings or infrastructure that is vital to the functioning of a community and to the flood response effort. If a critical facility is flooded, workers and resources may be unnecessarily drawn away from protecting the rest of the community. If such a facility is adequately prepared, it will be better able to support the community's flood response efforts.

Critical facilities include emergency operations centers, police and fire stations, hospitals, and roads and bridges. Critical facilities also include those buildings or locations that, if flooded, would create secondary disasters such as hazardous materials facilities, water and wastewater treatment plants, pump stations, schools, and nursing homes.

The State Hazard Mitigation Plan identifies 22 state-owned facilities in Calvert County that are at risk from at least one hazard. The State Plan also identifies four critical and state-owned facilities that are at risk of at least four hazards: erosion, flood, surge, and

radiological activity. These facilities include: the University of Maryland Center for Environmental Science, University of Maryland Chesapeake Biological Lab, University of Maryland Center for Environmental and Estuarine Studies, and University System of Maryland Warehouse. Calvert County has the second highest number of critical and state-owned facilities at risk in Maryland.

## Lifelines and Infrastructure

Lifelines and infrastructure are separated into distinct classes to provide the ability to differentiate between varying lifeline system components with substantially different damage and loss characteristics. For this project, lifelines and infrastructure include dams, bridges and airports. Lifelines and infrastructure were assessed using HAZUS-MH data.

## Total Exposure

According to the data obtained from HAZUS-MH, the total property exposure in Calvert County is estimated at $8.4 billion. Of that, residential property accounts for over 76.5%, estimated at $6.5 billion. The next highest category of occupancy in Calvert County was commercial, estimated at $1.295 billion or 15.3%. Table 28 lists the total exposure by occupancy class, infrastructure and lifelines, and critical facilities in Calvert County, as well as the source of the data.

**Table 28: Calvert County Assets**

| Parameter | Number | Value of Structures | Data Source |
|---|---|---|---|
| People | 88737 | | Census 2010 |
| Residential | 28181 | 8,479,004,000 | HAZUS-MH |
| Commercial | 1250 | 6,483,19,5000 | HAZUS-MH |
| Industrial | 463 | 303,897,000 | HAZUS-MH |
| Agricultural | 108 | 33,338,000 | HAZUS-MH |
| Religious | 126 | 197,036,000 | HAZUS-MH |
| Government | 32 | 51,782,000 | HAZUS-MH |
| Education | 42 | 113,822,000 | HAZUS-MH |
| Critical Facilities | | | |
| Fire Stations/EMS | 9 | 15,176,066 | Calvert County GIS |
| Police Stations | 7 | 11,784,832 | Calvert County GIS |
| Schools | 27 | 268,457,144 | Calvert County GIS |
| Hospitals/Urgent Care | 3 | 51,970,900 | Calvert County GIS |
| Other Special Considerations | | | |
| Toxic Release Sites | 339 | | EPA |

## Impacts on Population, Buildings, and Critical Facilities

After the critical facilities were identified and mapped, the focus of the asset identification shifted to assessing vulnerability on a per-hazard basis. Based on the hazard event profiling that was described in the previous sections, GIS data analysis was used to inventory the total number of structures as well as the critical facilities that are potentially vulnerable to the identified high risk hazards, including coastal/shoreline erosion, flooding, hurricane/tropical storm, severe storm, and tornado. Hazards such as,

tornadoes and severe storms are not mapped at the county level as they are likely to impact the entire county or undefined locations within the county. As such, the entire county must be considered vulnerable to these hazards. In regard to the other identified hazards, coastal/shoreline erosion and flooding, maps showing specific hazard locations are included.

## Loss Estimation

Describing vulnerability in terms of dollar losses provides the communities and the State with a common framework with which to measure the effects of hazards on assets. However, the dollar losses obtained through this process are estimates only and should not be used for other purposes.

The basic process for determining loss estimates requires initially assessing the level of damage from a hazard event, both as a percentage of the asset's structural and content replacement value, and as a loss of function. Next, the level of damage percentage is multiplied by the value of the structure, contents and use. In this manner, comprehensive loss estimation can be developed which includes the risk to a structure itself, as well as the contents and functions of the structure.

The damage estimate methodology was based on FEMA's, "Understanding Your Risks, Identifying Hazards and Estimating Losses". The result is an estimate of the potential hazard losses that could occur due to an event impacting Calvert County and causing damages.

### *Coastal/Shoreline Erosion*

Description of Vulnerability

The Chesapeake Bay Cliff Erosion in Calvert County Draft Steering Committee Report (2010) states that erosion is one of the most significant problems currently facing Maryland's diverse coastal environment. Today, approximately 69% of Maryland's coastline is experiencing some degree of erosion. Studies estimate that Maryland loses approximately 260 acres per year to shore erosion. Sea level rise influences on-going coastal processes that drive coastal erosion, in turn making coastal areas ever more vulnerable to both chronic (on-going) erosion and episodic events (e.g., tropical storms, hurricanes). Such impacts pose a significant threat to the steep cliffs, wetlands and marshes, tidal estuaries, sandy beaches, and barrier islands that comprise Maryland's coastal environment.

Erosion rate is a measurement of the landward movement of the shoreline over time, based on a comparison of shoreline cross sections at two points in time. Historic erosion rates were determined from the two most recent shoreline studies available for the Calvert County coast.

According to the Maryland Geological Survey, from Scientists Cliffs northward, the available shoreline cross sections are from 1960 and 1993; south of Scientists Cliffs the available shoreline cross sections are from 1942 and 1993. Erosion rates are typically historical averages over relatively long timespans, and may not accurately represent rates on shorter time scales, or reflect specific slumping occurrences.

Based on these data, the cliffs in Calvert County have eroded at an average rate of less than 2 feet per year. Some of the impacts from shoreline erosion include the direct loss

of land and its economic, cultural, and ecological values as well as the offsite impacts caused by increased sediment.

Based on maps indicating the rate of erosion for various segments of the Calvert County coastline, a 100-year erosion zone was identified. There are 597 properties in Calvert County that may be affected by erosion in the next 100 years. These properties represent a significant portion of existing development along the Calvert County shoreline. The properties have not been assessed to determine which ones may already be mitigated or protected by existing measures such as existing bulkheads, riprap, or other methods to stabilize the rate of erosion, but include all structures or footprints within the zone (see Table 29).

**Table 29: Structures Subject to Coastal/Shoreline Erosion**

| | Structure Count | Land Value | Improvement Value | Total Value |
|---|---|---|---|---|
| Chesapeake Beach | | | | |
| Government/Institutional | 2 | $ 89,220 | $ 0 | $ 89,220 |
| Commercial | 1 | $ 85,300 | $ 90,900 | $ 176,200 |
| Residential | 87 | $ 8,666,340 | $ 7,766,930 | $ 16,433,270 |
| Townhouse | 48 | $ 2,547,165 | $ 4,447,820 | $ 6,994,985 |
| SUBTOTAL | 138 | $ 11,388,025 | $ 12,305,650 | $ 23,693,675 |
| North Beach | | | | |
| Apartments | 2 | $ 260,800 | $ 29,900 | $ 290,700 |
| Commercial | 9 | $ 1,024,420 | $ 629,100 | $ 1,653,520 |
| Government/Institutional | 6 | $ 485,640 | $ 0 | $ 485,640 |
| Residential | 32 | $ 2,729,090 | $ 2,195,070 | $ 4,924,160 |
| SUBTOTAL | 49 | $ 4,499,950 | $ 2,854,070 | $ 7,354,020 |
| Calvert County | | | | |
| Agriculture | 5 | $ 555,810 | $ 555,300 | $ 1,111,110 |
| Commercial | 4 | $ 708,310 | $ 358,480 | $ 1,066,790 |
| Government/Institutional | 8 | $ 1,178,690 | $ 276,780 | $ 1,455,470 |
| Residential | 382 | $ 40,545,300 | $ 34,943,050 | $ 75,488,350 |
| Residential Condominium | 11 | $ 856,680 | $ 680,410 | $ 1,537,090 |
| SUBTOTAL | 410 | $ 43,844,790 | $ 36,814,020 | $ 80,658,810 |
| TOTAL | 597 | $ 59,732,765 | $ 51,973,740 | $ 111,706,505 |

According to the 2010 Calvert Cliffs Steering Committee report, Calvert County staff identified 234 homes situated along the Chesapeake Bay cliffs of Calvert County that are within 100 feet of the cliffs. The properties are located in the following areas: Chesapeake Beach, Huntingtown, Port Republic, Prince Frederick, St. Leonard, and Lusby. Within these areas are the following communities: Randle Cliffs, Locust Grove, Holiday Beach, Camp Roosevelt, Roosevelt Cliffs, Willows Colony, Dares Beach, Windcliff, Scientists Cliffs, Kenwood Beach, Western Shores, Calvert Beach, Long Beach, Cove Lake, Park Chesapeake, and Chesapeake Ranch Estates. Considering the degree of accuracy and age of the data, the housing count provides a good estimate, although not necessarily a final count of the number of homes within 100 feet of the cliffs.

A copy of the entire report can be found on the Calvert County website. http://www.co.cal.md.us/assets/SteeringCommitteeDraftReport.pdf

According to the 2011 Maryland State Hazard Mitigation Plan Update, A total of 242 state-owned facilities and 1,018 critical facilities are identified within the 100-foot risk zone. There are zero critical facilities within the high risk zone (>-8 ft/yr) directly. The majority of the critical facilities fall in the categories for above ground and underground storage facilities for oil. Of these, 30 critical facilities and 2 state-owned facilities are located in Calvert County.

### *Flooding*

Description of Vulnerability

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, and infrastructure. Damage to buildings, particularly residential buildings, is usually the largest single flood problem a community faces.

There are a significant number of people living along the coastal and riverine floodplains of Calvert County who would be affected by flooding resulting primarily from thunderstorms, tropical storms, hurricanes, and nor'easters. The probability of repeated inland flooding, inability to accommodate the existing drainage problems due to a lack of funding, and the location of housing stock that was constructed prior to the issuance of Flood Insurance Rate Maps, results in a high level of vulnerability. A significant number of people can be affected by flooding. The economic costs are high and the response costs are moderate; therefore, the vulnerability to flooding is high in Calvert County.

According to the 2011 Maryland State Hazard Mitigation Plan update, there are 55 critical facilities valued at $2,445,813 and 5 state facilities valued at $1,935,284 located within the FEMA 100-year flood zone.

The properties located in or adjacent to the 100-year floodplain, as shown on the communities' Floodplains are shown in Figure 14. A significant portion of existing development in the County is located in 100-year flood zones and is vulnerable to flooding and flood damages (see Table 30).

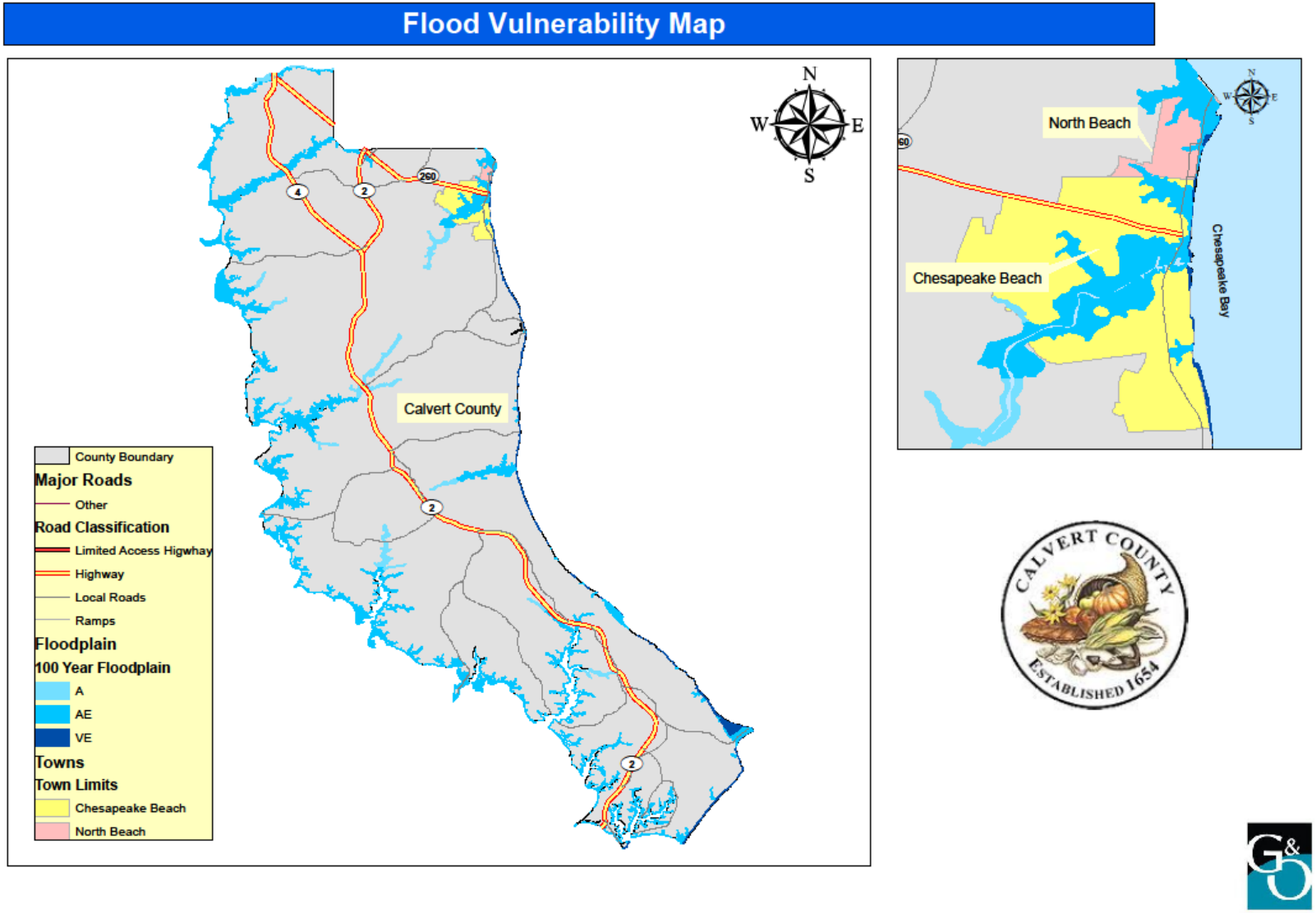


**Figure 14: Flood Vulnerability Map**

**Table 30: Flood Vulnerability (2000 Census Data)****

| Flood | Structure Count | Land Value | Improvement Value | Total Value |
|---|---|---|---|---|
| Chesapeake Beach | | | | |
| Agricultural | 1 | $ 71,630 | $ 110,690 | $ 182,320 |
| Apartments | 2 | $ 439,810 | $ 1,707,190 | $ 2,147,000 |
| Commercial | 25 | $ 8,184,000 | $ 3,300,870 | $ 11,514,870 |
| Government/Institutional | 5 | $ 676,890 | $ 2,468,000 | $ 3,144,890 |
| Residential | 56 | $ 3,080,970 | $ 3,077,060 | $ 6,158,030 |
| Townhouse | 154 | $ 9,744,365 | $ 14,186,100 | $ 23,930,465 |
| SUBTOTAL | 243 | $ 22,227,665 | $ 24,849,910 | $ 47,077,575 |
| North Beach | | | | |
| Commercial | 17 | $ 1,233,120 | $ 8,216,100 | $ 9,449,220 |
| Government/Institutional | 9 | $ 145,675 | $ 0 | $ 145,675 |
| Residential | 103 | $ 5,800,710 | $ 5,717,640 | $ 11,518,350 |
| Residential/ Commercial | 11 | $ 358,250 | $ 563,590 | $ 921,840 |
| SUBTOTAL | 140 | $ 7,537,755 | $ 14,497,330 | $ 22,035,085 |
| Calvert County | | | | |
| Agricultural | 30 | $ 2,074,110 | $ 1,655,040 | $ 3,729,150 |
| Commercial | 31 | $ 6,456,600 | $ 8,051,050 | $ 14,507,650 |
| Government/Institutional | 18 | $ 3,596,980 | $ 159,210 | $ 3,756,190 |
| Marsh Land | 2 | $ 1,710 | $ 0 | $ 1,710 |
| Residential | 902 | $ 73,406,415 | $ 66,225,830 | $139,632,245 |
| Condominium | 129 | $ 3,729,900 | $ 6,360,270 | $ 10,090,170 |
| Townhouse | 22 | $ 913,780 | $ 1,843,500 | $ 2,757,280 |
| SUBTOTAL | 1134 | $ 90,179,495 | $ 84,294,900 | $174,474,395 |
| TOTAL | 1517 | $ 119,944,915 | $123,642,140 | $243,587,055 |

** HAZUS-MH has not been updated with 2010 Census data**

A more detailed flood vulnerability assessment was performed by Vision Planning and Consulting, LLC, along with the Eastern Shore Regional GIS Cooperative at Salisbury University. This assessment is separately included in the Calvert County Flood Mitigation Plan. According to this assessment, there are 577 buildings located in the 100 year floodplain. Using dollar values from 2007 tax assessments, the total assets at risk of flood damage from a 100 year flood event is $168 million and the estimated damages are $30 million.

A copy of the Calvert County Flood Mitigation Plan is included as **Appendix B**.

### *Hurricane/Tropical Storm*

Description of Vulnerability

A number of people who live along the Calvert County coastline would be affected by hurricane storm surge. High winds from hurricanes would affect the entire population of

Calvert County. Tall structures, like radio towers, can be destroyed by hurricane force winds and some structures, such as mobile homes are particularly at risk.

Inland flooding from hurricane rains can also impact Calvert County residents. A hurricane can bring 6 to 12 inches of rainfall to the area it crosses, and some have brought much more. The rain can impact traffic, overtax the stormwater drainage system, and hamper evacuation routes that could severely reduce the number of hours available for the overall evacuation.

Calvert County is considered to have a high vulnerability to hurricanes due to existing development, coastal population, and age of the structures and the history of events. The number of people affected by hurricanes and coastal storms is significant, the economic and response costs are high, the likelihood of hurricanes and coastal storms is moderate, and the vulnerability is high.

To measure the vulnerability of Calvert County's infrastructure to hurricanes or other coastal events, a hazard scenario was run on HAZUS-MH. The probabilistic scenario calculated the damages based on 10-, 20-, 50-, 100-, 200-, 500-, and 1,000-year hurricane events (Figure 15).

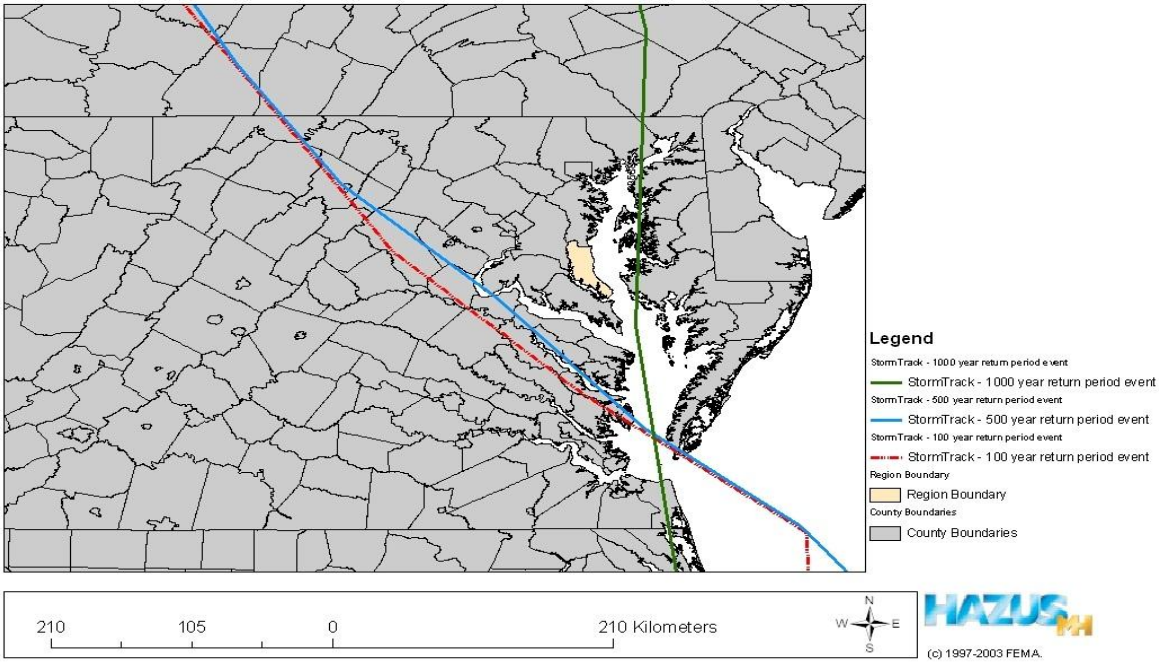


**Figure 15: Calvert County Probabilistic Hurricane Scenario**

Based on these 3 events, HAZUS-MH predicts that there would only be 1 displaced household for the 100-year event; however that figure climbs to 254 households for the 500-year event and 1,086 households for the 1,000-year event. Only 40% of the schools would be functional immediately following the 100-year event. An estimated 919,240 tons of debris would be generated from the 100-year event. This would increase to over 1,295,828 tons for a 500-year event and 1,591,683 tons for a 1,000-year event.

In terms of building damages, HAZUS-MH estimates that 213 building will be at least moderately damaged in a 100-year event. Of these, 3 will be completely destroyed. In a 500-year event, the number of buildings sustaining at least moderate damage increases to 4,552, of which 41 are estimated to be commercial structures. An estimated 8,141

structures would sustain at least moderate damages in the 1,000-year event. Of these, over 1,200 are estimated to be completely destroyed.

HAZUS-MH also calculated the estimated annualized losses from all projected hurricane events. The annualized losses are estimated at $4,222,000 for Calvert County. These losses are comprised of building damages – $2,719,000; content damages – $1,046,000; inventory losses – $3,000; relocation losses – $313,000; capital related losses – $17,000; wages losses – $22,000; rental income losses – $102,000. .

### *Severe Storm*

Description of Vulnerability

Severe storms can strike anywhere in the county; therefore, specific building counts are not available to assess the vulnerability of this hazard. Impacts from severe storms have been moderate, with localized flooding occurring from severe thunderstorms, minor damages from high wind events, and power and transportation disruptions from winter storms. In addition, winter storms and freezes impact a widespread area of crops and livestock depending on when the event occurs. The impact from hail and lightning has been limited to minor damages at specific locations. Severe storms can have a major economic impact on Calvert County when the utility systems, including electricity, are disrupted for an extended period of time.

Estimate of Losses

The losses associated with severe storms are a result of structural damages, content damages, and a loss of business.

### *Tornado*

Description of Vulnerability

Tornadoes are unpredictable in their pattern, frequency, and severity; therefore, all of Calvert County is vulnerable to tornado-induced damages. The impact on the county varies based on the severity of the tornado and location of impact. The damages from tornado events are greatest in the immediate area affected. Vulnerable populations include those in mobile home parks, recreational vehicles, and aged or dilapidated housing.

Mobile homes (826) account for less than 1% of the structures in the county. An additional 19.5% of the structures in the county were built prior to 1970

According to the 2011 Maryland State Hazard Mitigation Plan update, there are 551 critical facilities valued at $415,662,333 and 123 state facilities valued at $149,722,737 in Calvert County that are susceptible to damage due to tornadoes.

## 2010 Updates to Chapter 5

As part of the 2010 update to this plan, this section was updated to include new census data as well as updated vulnerabilities information. Data from the Calvert County Flood Mitigation Plan and the 2010 Calvert Cliffs Steering Committee report was also added to this section.

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# CHAPTER 6 – COMMUNITY CAPABILITY ASSESSMENT

## Overview

This section assesses what loss prevention mechanisms and capabilities are currently in place in Calvert County and the incorporated communities. This helps to focus the Goals, Objectives and Proposed Actions of this plan on issues or areas that have not already been addressed. Calvert County has a number of resources that it can access to implement hazard mitigation initiatives. These resources include both private and public assets at the local, state, and federal levels. The following table summarizes the local government capabilities the county and the municipalities possess that will facilitate implementation of the mitigation strategy and provides a snapshot view of the communities' basic mitigation capabilities based on their existing codes and ordinances.

## Capability Assessment Methodology

A detailed Hazard Mitigation Capabilities Assessment Questionnaire was prepared and distributed to all jurisdictions for input. The Hazard Mitigation Capabilities Assessment Questionnaire was designed to assess the community's ability to reduce future losses from all hazards through its various policies and programs. The intent of the capability assessment was to provide an inventory of existing policies, programs, practices and operational responsibilities that have or may have a major role in helping the communities in their overall efforts to mitigate hazards. The results of the questionnaire are integral to the development of a mitigation strategy, and serve as the backbone of a local hazard mitigation plan. The questions presented in the questionnaire covered several different agencies within the jurisdictions, particularly the county. These agencies or positions included: Planning Department; Department of Public Works; Floodplain Management; Tax Assessor's Office; Grants Administration; and Municipal Executive Administrators (Mayor, City Manager, Chairperson).

Two of the most important capabilities that the municipalities utilize are the floodplain management ordinances and the building codes. Through administration of the floodplain ordinances, the municipalities can ensure that all new construction or substantial improvements to existing structures that are located in the 100-year floodplain are built with first-floor elevations above the base flood elevation.

Building codes are important in mitigation because codes are developed for regions of the country in consideration of the hazards present within that region. Consequently, structures that are built to applicable codes are inherently resistant to many hazards like strong winds, floods, and earthquakes and can help mitigate regional hazards like tropical storms.

Generally, there are three pieces of legislation, which are all related to land use and development and complement and reinforce the goals and objectives of the Hazard Mitigation Plan. They are the Comprehensive Plan, Subdivision Regulations and the Zoning Ordinance.

Table 31 is a summary of how each of these documents contributes to an overall hazard mitigation framework. Each point identifies where and how mitigation concepts, principles and measures are integrated into the normal day-to-day activities of the local governments.

**Table 31: Capability Matrix**

| | Unincorporated Calvert County | Town of Chesapeake Beach | Town of North Beach |
|---|---|---|---|
| Comprehensive Plan | Yes (2010) | Yes (2010) | Yes (2011) |
| - with Hazard Mitigation? | No | No | No |
| Land Use Plan | Yes | Yes | Yes |
| Subdivision Ordinance | Yes | Yes | Yes |
| Zoning Ordinance | Yes | Yes | Yes |
| BFM Plan?? | No | No | No |
| HM Plan etc. | Yes (2005) | No | Yes (2005) |
| FPM Ord | Yes (2011) | Yes | Yes |
| - Sub. Damage? | Yes | Yes | Yes |
| - Administrator? | Yes | Yes | Yes |
| - # of FP Buildings? | 1,101 | 264 | 152 |
| - # of policies | 544 | 189 | 87 |
| - # of Losses? | 291 | 65 | 95 |
| CRS Rating | 10 | 10 | 10 |
| Stormwater Program | Yes | Yes | Yes |
| Building Code | 2009 International Building Code, 2009 International Residential Code (IRC) | 2009 International Building Code, 2009 International Residential Code (IRC) | 2009 International Building Code, 2009 International Residential Code (IRC) |
| Building Official | Yes | No | No |
| - Inspections? | Yes | Yes (County) | Yes (County) |
| LEOP? | Yes | No | No |
| Warning-sirens? | No | No | No |
| - NOAA Weather Radio? | Yes | Yes | Yes |
| - Cable Override? | Yes | Yes | Yes |
| - Reverse 911? | Yes | No | No |
| Potential Structural Projects | Yes | Yes | Yes |
| Potential Property Protection | Yes | Yes | Yes |
| Critical Facility Protection | Yes | Yes | Yes |
| Nat/Cultural Resources Inv. | Yes | No | No |
| Erosion Control | Yes | Yes | Yes |
| Sediment Control | Yes | Yes | Yes |
| Pub. Info Program | Yes | Yes | Yes |
| Environmental Ed Program | Yes | Yes | Yes |

*Note: Some services in the Towns of Chesapeake Beach and North Beach are provided by the County.*

## EXPLANATION OF CAPABILITY ASSESSMENT MATRIX

**Comprehensive Plan:** Does your community have a Comprehensive Long-Term Community Growth Plan?

**Land Use Plan:** Does your community have a plan that designates type of Land Use desired/required?

**Subdivision Ordinance:** Does your community have an ordinance that dictates lot sizes, density, setbacks, construction type, etc?

**Zoning Ordinance:** Does your community have an ordinance that dictates type of Use and Occupancy in certain areas?

**BFM Plan:** Does your community have a Beachfront Management Plan?

**HM Plan:** Does your community have an existing stand-alone Hazard Mitigation Plan?

**FPM Ordinance:** Does your community have a Floodplain Management Ordinance: Directs development in identified Flood Hazard Areas.

**Substantial Damage:** Does your FPM Ordinance contain language on Substantial Damage/Improvements?

**Administrator:** Does your community have a Floodplain Administrator (someone responsible for enforcing the ordinance)?

**Number of FP Buildings:** How many buildings are in the floodplain in your community?

**Number of Policies?** How many buildings in the floodplain are insured against flood through the NFIP?

**Number of Repetitive Losses:** How many NFIP Repetitive Losses are in your community? (Paid > $1,000, twice in the past 10 years)

**CRS Rating:** Are you in the Community Rating System of the NFIP, and if so, what's your rating?

**Stormwater Program:** Does your community have a Stormwater Management program?

**Building Official:** Does your community have a Building Official?

**Inspections:** Does your community conduct building inspections during and after completion of the development process?

**BCEGS:** Building Code Effectiveness Grading System Rating

**LEOP:** Does your community have a Local Emergency Operations Plan (a disaster RESPONSE plan)?

**Warning:** Do you have any type of system, such as: Sirens? NOAA Weather Radio reception? Cable (TV) Override? “Reverse 911”? How much “lead time” is provided?

**Structural Protection Projects:** (levees, drainage facilities, detention/retention basins)

**Property Protection Projects:** (buy-outs, elevation of structures, floodproofing, small "residential" levees or berms/floodwalls)

**Critical Facility Protection:** (for example, protection of power substations, sewage lift stations, water-supply sources, the EOC, police/fire stations, medical facilities that are at risk – e.g., in the floodplain)

**Natural And Cultural Inventory:** Do you have an inventory of resources, maps, or special regulations within the community? (Wetlands and historic structures/districts, etc.)

**Erosion Or Sediment Control:** Do you have any projects or regulations in place?

**Public Information and/or Environmental Education Program**: Do you have an ongoing program even if its primary focus is not hazards? Examples would be "regular" flyers included in city utility billings, a website, or an environmental education program for kids in conjunction with Parks & Recreation?)

## Existing Plans and Reports

Calvert County has a Commissioner form of government with 5 elected County Commissioners overseeing the executive and legislative functions of the government.

Comprehensive Plan, 2010:

- The county has instituted strong conservation techniques to protect wetlands, flood plains and steep slopes since the 1980's. In 1989, the State mandated the establishment of a Critical Area within 1,000 feet of the county's waterways. The allowable density within most of this area was reduced to 20 acres per dwelling unit. The Forestry Management Act, adopted in 1993 and designed to protect large contiguous forested areas, was also mandated by the State.
- Expand the future land use element to include property protection, by identifying priority investment areas that are at less risk to hazards than others. This element can also call for adequate roads to reduce evacuation times by improving evacuation capacity.
- Identify the cultural resources and prepare a disaster preparedness plan for the county's many historic resources.

Calvert County Zoning Ordinance, 2010

- Used to achieve the objectives of the Comprehensive Plan, it addresses setbacks, buffers, wetland and natural resource protection, and drainage.
- Natural Resource Protection Areas are identified to protect areas susceptible to flooding and erosion hazards. Also addresses steep slope development as well as wetland protection.
- Identifies flood control design criteria for retention/detention ponds; collector, local streets and closed drainage systems; roadside swales; canals and major ditches; and bridges. Uses a 25-year standard for design purposes.
- The county could benefit by hosting pre-disaster training on FEMA's Residential Substantial Damage Estimator (RSDE), a damage assessment software program specifically designed to support decision-making by local building officials when addressing "substantial damage" issues.

Calvert County Floodplain Management Ordinance, August 2011

- The ordinance was originally developed in 1984 and has only undergone two subsequent revisions, in 1988 and again in 1992. There have been a number of major flooding events since the last update including Hurricane Floyd and Hurricane Isabel which have caused major damages in the county.

- The ordinance requires as-built Elevation Certificates to show structures are elevated to or above the Flood Protection Elevation.
- Manufactured Homes are not permitted in the coastal high hazard area. Also, consider requiring substantial improvements or repairs of manufactured homes in any high hazard area to be elevated above the base flood elevation and anchored according to FEMA's latest recommendations.

The Town of Chesapeake Beach has a Mayor/Council form of government with six elected Town Council members and an elected Mayor that oversees the executive and legislative functions of the government.

Chesapeake Beach has the following plans and ordinances in place to assist with implementing the goals and objectives of the Hazard Mitigation Plan

- Comprehensive Plan (2010)
- Floodplain Ordinance (2011)
- Stormwater Management Plan (Adopted County Plan)
- Zoning Ordiance (2010)
- Subdivision Regulations (2006)

Chesapeake Beach has a Stormwater Program and utilizes the building codes administered by Calvert County to assist with implementing the goals and objectives of the Hazard Mitigation Plan

The Town of North Beach has a Mayor/Council form of government with an elected Town Council that oversees the executive and legislative functions of the government.

North Beach has the following plans and ordinances in place to assist with implementing the goals and objectives of the Hazard Mitigation Plan

- Comprehensive Plan (2011)
- Floodplain Ordinance (1991)
- Stormwater Management Plan (2010)
- An on-going Capital Improvement Plan

Some additional capabilities that appeared as regulations, policies, or actions taken by the county and towns that will strengthen the capability for mitigation are listed below. The items that are shown in ***bold underline italicized*** text are items that may be considered as part of the mitigation strategy in this mitigation plan.

- In 1998 and 1999, the Board of County Commissioners (BOCC) and Planning Commission conducted a thorough analysis of the costs and benefits of reducing build-out and adopted a program to reduce build-out in March 1999. The program includes a combination of zoning ordinance changes, new funding for land preservation and incentives.
- The county has a policy not to locate public facilities such as sewer or water service areas, schools, and fire and rescue stations within the Farm Community District or the Resource Preservation District.
- The county is working with existing communities that contain large numbers of platted undeveloped lots to determine whether or not the health and safety needs

of existing and future residents within these communities can be met. If not, they are developing policies to address health and safety issues, including, if necessary, approaches to reduce the number of platted lots that can be developed.

- Watershed Management Plans have been prepared for Parkers Creek and Huntingtown. ***The county plans to develop watershed management plan for all of the major tributaries in the county.***
- The Public Works Department has initiated stormwater management studies for the Town Centers and continues to work with Drum Point and Chesapeake Ranch Estates to address stormwater management problems.
- The Public Works Department continues to review and keep up with changes in sediment and stormwater management standards and regulations. They inspect and address complaints within one working day and coordinate with Maryland Department of the Environment inspectors on joint inspections of sites involving site grading and stormwater management construction. They are working to improve the notification process with MDE for their jurisdictional authority over various site inspections.
- Forest cover has been digitized from topography maps. Forest gain and loss in the Critical Area is tracked through building permits.
- The County plans to restore or create wetlands in disturbed areas. ***A first step would be to locate and map disturbed wetland areas.***
- Elevation requirements minimize damage to structures. By no longer permitting new lots in flood plains, damage to the environment has been reduced. ***Buildings can still be built on existing lots of record within floodplains***.
- The County and towns review Subdivision Regulations, Zoning Ordinance and the Sediment Control Ordinances concerning development, grading and alteration of natural vegetation on areas with severe slopes. The Public Works Department proposed including a section in the Erosion and Sediment Control Ordinance pertaining specifically to disturbance within severe slope areas.
- The County developed regulations to address development on steep slopes on existing lots and parcels***.***
- The County wants to develop methods to protect the habitats of rare, threatened and endangered species, and take steps to increase their numbers, if possible. ***The identification and mapping of these habitats should be considered.***
- The county has a standard of providing 30 acres of recreational open space per 1,000 population. A. Give priority in next five years to natural, cultural, and historic sites. B. Develop a full range of recreational sites and facilities in or near Town Centers to include 1) a town park or "village green" 2) an in-town trail and bikeway system that connects to extended greenways 3) an outdoor public facility for team sports and 4) an indoor community center. In addition, in major Town Centers, include an indoor sports complex and swimming pool. C. Connect county-wide parks to each other and to Town Centers by way of public greenways.

- ***The county has a goal to increase public awareness and knowledge of disasters affecting the county so that appropriate actions may be taken by citizens, businesses and industry to reduce loss of life and property.***
- The County and towns will maintain all disaster and emergency plans in a current status; implement new plans as needed to address safety hazards and population growth.
- The County and towns will continue to monitor response times and periodically evaluate the need for additional Fire, EMS, and Police stations.
- The county promotes the use of their website and the internet as one means of providing information to the public.

Ever since the first Calvert County Comprehensive Plan was adopted in 1966, one of the County's primary goals has been the preservation of its rural character. In 1978, the Agricultural Preservation Advisory Board set a goal of preserving 20,000 acres. In 1997, Calvert County celebrated the enrollment of 20,000 acres of prime farm and forestland in County and State land preservation programs. A goal to preserve an additional 20,000 acres was adopted that year. To help meet the new goal, the County allocated an additional $2,000,000 per year toward land preservation including an additional $500,000 added to the Purchase and Retirement (PAR) Fund, $500,000 in local support for the Maryland Agricultural Land Preservation program, and $1,000,000 for a new County leveraging program (an installment purchase program). The County also actively participated in the Maryland Rural Legacy Program. The County's current goal is to permanently preserve a minimum of 40,000 acres of prime farm and forestland through County, State, and federal land preservation programs.

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# CHAPTER 7 – MITIGATION STRATEGY

This section presents a mitigation strategy to help Calvert County reduce the losses and effects of future hazard events. Mitigation goals and objectives were developed to address the vulnerabilities identified in Chapter 4 and specific mitigation actions were selected and prioritized. An implementation strategy of who is responsible for the action, how it will be completed and possible funding sources is also included.

## Goals and Objectives

Following is a list of the Calvert County goals and objectives:

| | | |
|---|---|---|
| **GOAL 1:** | **Minimize future losses from all disasters by reducing the risk to people and property.** | |
| | 1.1 | Protection of populations and properties in Calvert County susceptible to economic or physical loss from disasters shall be consistent with the standards established in the Calvert County Hazard Mitigation Plan and the Calvert County Comprehensive Plan. |
| | 1.2 | Provide protection of critical facilities vital to disaster response, such as fire and police, and those vital to the continuous operations of the county, such as hospitals and health care facilities, water and sewer facilities, electrical and other utility, and transportation systems. |
| **GOAL 2:** | **Support a balance between government regulation/enforcement, and personal awareness/responsibility for hazard mitigation, by emphasizing education and training for property owners, families and individuals.** | |
| | 2.1 | Develop and support disaster preparedness education and awareness programs, targeting specific benefits to homeowners, families, and individuals. |
| | 2.2 | Develop and support disaster preparedness education and awareness programs, targeting specific benefits to public and private sectors. |
| | 2.3 | Develop and support economic incentive programs for both public and private sectors promoting benefits of structural retrofitting. |
| **GOAL 3:** | **Prevent flood-related repetitive losses from natural disasters through regulation and education.** | |
| | 3.1 | Develop and support public and private projects and programs to retrofit, relocate, or acquire properties susceptible to repetitive flooding. |
| | 3.2 | Require systematic maintenance programs for stormwater management systems. |
| | 3.3 | The county shall direct population concentrations away from known or predicted high hazard areas through appropriate regulations. |

| | | |
|---|---|---|
| **GOAL 4:** | **Reduce economic vulnerability and increase recovery capabilities of business and industry.** | |
| | 4.1 | Develop and implement disaster planning training through collaborative programs with appropriate government agencies and community organizations. Programs should include seminars and handout materials addressing needs relevant to businesses. |
| **GOAL 5:** | **Emphasize pre- and post-disaster planning to decrease vulnerability of existing and new construction to loss.** | |
| | 5.1 | Promote to elected officials, builders, and potential homeowners, the economic and safety benefits of designing mitigation features into new construction. |
| | 5.2 | Identify vulnerable existing public and private critical facilities and encourage pre-disaster retrofit. |
| | 5.3 | Offer and support incentives and education to encourage higher standards of protection to structures and facilities from hazards. |
| | 5.4 | Promote accuracy of Flood Insurance Rate Maps (FIRMs) by requesting FEMA restudy. |
| **GOAL 6:** | **Encourage public support and commitment to hazard mitigation, by communicating its benefits and justification in simple and understandable terms.** | |
| | 6.1 | Develop and implement public information programs for hazard mitigation, emphasizing its direct benefits to citizens, including public officials and private businesses. |
| | 6.2 | Identify and coordinate hazard mitigation public information programs and events such as contests and festivals with public and private partners. |
| | 6.3 | Identify and seek multiple funding sources that will support hazard mitigation awareness and training programs. |
| **GOAL 7:** | **Ensure hazard mitigation goals are consistent with existing plans.** | |
| | 7.1 | Promote hazard mitigation goals through implementation into existing plans and report. |
| | 7.2 | Encourage hazard mitigation through the development of new plans and reports. |

## Range of Mitigation Initiatives and Policies

The process of integrating the goals and objectives with the identified vulnerabilities within Calvert County was completed in order to produce a series of specific mitigation actions relevant to protecting lives and properties in Calvert County. Incentives for implementing hazard mitigation incentives are normally related to loss reduction, public welfare, or public safety. Disincentives are typically related to lack of funding, staff, or resources.

Developing a range or list of existing and proposed mitigation initiatives and the policies, ordinances, and regulations that guide these efforts allows achievement of hazard

mitigation planning objectives. Results of the hazard identification and vulnerability assessment provided insights for these initiatives in Calvert County. The Planning Team identified a range of mitigation initiatives and policies from the following categories:

- **Preventive measures** are designed to minimize the potential development of new natural hazard problems and are intended to keep existing natural hazard problems from becoming worse. They ensure that future land development projects do not increase local and/or regional natural hazard damage potentials. Preventive measures are usually administered by local building, zoning, planning, and/or code enforcement officials and typically include the following:
    - Land use planning/zoning efforts
    - Subdivision and land development ordinances
    - Building codes
    - Floodplain development regulations
    - Stormwater management
    - Operations and maintenance (O&M) procedures
    - Subsurface investigation requirements
    - Public education programs
- **Emergency services** measures protect people during and immediately following a natural hazard event. Counties and municipalities typically develop an Emergency Operations Plan (EOP) to formally document their emergency preparedness and response planning. The local EOP identifies standard operating guidelines for various emergency management personnel and establishes the location and operating conditions of the Emergency Operations Center (EOC). As such, adopting and implementing the EOP is a critical first step in providing local emergency services measures in response to a natural hazard event.

    Emergency services measures can be implemented at the local, county, State, and/or Federal level, depending on the severity of the hazard event, and typically include the following:
    - Hazard warning
    - Hazard response
    - Critical facilities protection
    - Health and safety maintenance
    - Post-disaster recovery and mitigation
- **Property protection** measures are used to minimize an existing structure's vulnerability to a known hazard, rather than trying to modify or control the hazard itself. Property protection measures involve improvements to privately owned property and must therefore be coordinated (and potentially even cost-shared) with the respective property owners. Many of these measures do not affect the appearance or use of the structure, which make them particularly appropriate for historical sites or landmarks. Implementation of a property protection measure typically requires acquisition of a local building permit. As such, property protection measures include the following:
    - Relocation/acquisition

- Elevation
- Floodproofing
- Insurance
- Brush/shrub removal
- Emergency response planning

- **Structural projects** are typically constructed to keep floodwaters and other natural hazards away from select areas. They are usually designed by engineers and managed or maintained by public works staff. From a flood hazard mitigation standpoint, structural projects can be used to control flows and water surface elevations for both flood minimization and recreational purposes. However, due to their limiting costs and potential environmental implications, structural projects are not normally constructed to protect individual properties, but are usually large-scale undertakings designed to protect numerous people and properties. As such, structural hazard mitigation projects typically include the following:
  - Dams/levees/floodwalls
  - Bridge/culvert modifications
  - Channel modifications/diversions
  - Firebreaks
  - Sinkhole abatement
  - Landslide abatement
  - Emergency water source development
- **Natural resource protection** activities that are implemented as hazard mitigation measures can be multiple in scope, purpose, and outcome. They are generally aimed at preserving (or in some cases restoring) local natural areas, environmentally sensitive resources, or the overall quality of some locally significant feature, but can also play a significant role in reducing local and regional damages caused by natural hazard events. Natural resource protection activities are typically implemented by park, recreation, or conservation agencies and organizations, but are not limited to these types of entities. Any responsible entity, such as a local government, can develop and implement a natural resource protection program that will minimize the impacts of natural hazards while enhancing the local and regional environment. Natural resource protection activities that can minimize the potential impacts of natural hazards include the following:
  - Open space preservation
  - Wetland protection
  - Identification and implementation of Best Management Practices (BMPs)
  - Water resources management planning
- Public Information includes providing the public with accurate and relevant information is a key component of a successful hazard mitigation program. Public information activities advise residents, business owners, and local officials about natural hazards and ways they can protect themselves, their property, and their constituents from these hazards. Public information activities can be aimed at the

entire county or at select residents and business owners in known hazard areas. These programs are intended to motivate people to take precautionary steps on a pre-disaster basis. These public information activities include the following:

- Map information
- Library resources
- Outreach projects
- Environmental education

## Identification and Analysis of Hazard Mitigation Measures

Each of the proposed mitigation actions was evaluated to assess level of impact to four elements: Life/Safety, Administrative/Legal, Capital Costs, and Operating/Maintenance. The Life/Safety element evaluated the direct and indirect impact on Calvert County residents, businesses, and public safety. The impacts were considered low if the mitigation action would have a minimal or negligible impact, moderate if the action would have an indirect impact, and high if the action would impact public safety.

The Administrative/Legal element assessed the feasibility of the mitigation action to determine if the county had the legal or statutory requirement or the administrative processes to complete the action. The impacts were considered low if the mitigation action did not satisfy a legal or statutory requirement. They were considered moderate if the action would result in improved data collection and storage or administrative processes. The impact was considered high if it satisfied a statutory requirement or if it was a continuance of a key function.

The Capital Costs element was evaluated to determine the costs of the mitigation actions. The impacts were considered low if the costs were estimated to be less than $50,000; moderate if the costs were $50,000 to $250,000; and high if the costs exceeded $250,000.

Finally, the Operating/Maintenance element was evaluated to determine the estimated on-going costs to the county from the mitigation action. The impacts were considered low if the on-going costs were less than $15,000; moderate if the costs were $15,000 to $30,000; and high if the costs exceeded $30,000.

## Timeframe

The proposed mitigation actions were also evaluated to determine the estimated implementation timeframe. Actions that were determined to be short-range had an implementation schedule within 1 year. Medium-range actions had an implementation schedule between 2 and 5 years and long-range actions had an implementation schedule between 5 and 10 years (see Table ).

**Table 32: Evaluation of Mitigation Actions**

| Goal/ Objective | Project Description | Life/ Safety Impact | Admin/ Legal Impact | Capital Costs | Oper./ Main. Costs | Time Frame |
|---|---|---|---|---|---|---|
| 1.1 | Encourage uninsured property owners in known flood hazard areas to purchase flood insurance through the NFIP | M | H | L | L | S |
| 1.1 | Evaluate all manufactured homes to ensure their resistance to wind and flood hazards | H | M | M | L | M |
| 1.1 | Consider expanding the automated emergency alert community calling system (Code Red) | M | L | L | L | S |
| 1.1 | Encourage property owners in potential wildfire hazard areas to remove all excess brush and shrubby plants from the immediate vicinity (i.e., 50 to 100 feet) of all buildings | H | L | M | M | S |
| 1.1 | Preserve the highest priority undeveloped steep slope areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical steep slope areas may be preserved/protected via local ordinance | H | H | H | M | L |
| 1.1 | Preserve critical undeveloped forested areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical forested areas may be preserved/protected via local ordinance | H | M | H | M | L |
| 1.1 | Preserve high priority wetland areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical wetlands may be preserved/protected via local ordinance? | H | M | H | M | L |
| 1.2 | Conduct routine inspections, regular maintenance, and annual tests on all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event | H | L | L | L | On-going |
| 1.2 | Coordinate with the local municipality and/or the Maryland Department of Transportation on the feasibility of replacing, removing, or enlarging those bridge and culvert stream crossings that are unable to pass the 10-year frequency flood flow | H | L | H | M | L |
| 1.2 | Provide adequate shelters, with backup power, in various parts of the county to serve as refuge areas during floods and other hazard events. | H | H | H | L | M |
| 2.1 | Ensure that a planned, coordinated, and effective public warning dissemination program exists at the local level | H | H | L | L | On-going |
| 2.1 | Work with local radio stations to promote continuity of public awareness and disaster preparedness. | H | L | L | L | On-going |

| Goal/ Objective | Project Description | Life/ Safety Impact | Admin/ Legal Impact | Capital Costs | Oper./ Main. Costs | Time Frame |
|---|---|---|---|---|---|---|
| 2.1 | Store in an easily accessible location and make available for public inspection, this hazard mitigation plan and the FEMA guidance documents that were provided as part of the hazard mitigation planning program | L | M | L | L | S |
| 2.1 | Maintain natural hazard risk assessment and mitigation publications/materials at public libraries throughout the County | L | M | L | L | S |
| 2.1 | Develop and distribute a public summary of this hazard mitigation plan including relevant information on hazard-prone areas, hazard specific "do's" and "don'ts" and emergency contact information | H | M | L | L | On-going |
| 2.1 | Implement a wildfire-prevention public education program consisting of the development and distribution of an informative brochure and training for local officials on Firewise Communities Program | M | M | L | L | M |
| 2.1 | Ensure that all documented information can be accessible from the County Internet/Intranet site. Provide pertinent public information on COMCAST. | L | M | L | L | On-going |
| 2.2 | Develop a technical proficiency at the municipal level for assisting local residents and business owners in applying for hazard mitigation/assistance funds and identifying cost beneficial mitigation measures to incorporate into reconstruction activities | L | H | L | L | M |
| 2.2 | Ensure continued contractor compliance with approved Erosion and Sedimentation Pollution Control Plans and continue to work with local farmers to implement BMPs | L | H | L | L | On-going |
| 2.2 | Workshops for local engineers, architects and contractors/builders on IBC and hazard resistant construction. | M | H | M | L | M |
| 2.2 | Coordinate with FEMA, MEMA, NWS, and any other appropriate entities on developing and implementing a natural hazard awareness curriculum in local schools | M | L | M | L | L |
| 3.1 | Dry floodproof known flood-prone structures in accordance with the general guidelines | H | M | M | L | M |
| 3.1 | Wet floodproof known flood-prone structures in accordance with the general guidelines | H | M | M | L | M |
| 3.1 | Preserve the highest priority undeveloped floodplain areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical floodplain areas may be preserved/protected via local ordinance | H | M | H | L | L |
| 3.1 | Elevate known flood-prone structures in accordance with the general guidelines | H | H | H | L | L |
| 3.1 | Relocate and/or acquire known flood-prone structures in accordance with the general guidelines | H | H | H | L | L |

| Goal/ Objective | Project Description | Life/ Safety Impact | Admin/ Legal Impact | Capital Costs | Oper./ Main. Costs | Time Frame |
|---|---|---|---|---|---|---|
| 3.2 | Ensure municipal compliance with local Stormwater Management Plans | H | H | M | L | M |
| 3.2 | Develop and implement a community-specific channel maintenance program consisting of routine inspections and subsequent debris removal | M | M | M | L | M |
| 3.3 | Store in an easily accessible location and make available for public inspection, the community's Flood Insurance Rate Mapping and associated Flood Insurance Study | L | M | L | L | S |
| 3.3 | Acquire and relocate structures along the cliffs of the Chesapeake Bay that are threatened by severe cliff erosion. | H | M | H | M | S |
| 4.1 | Develop a technical proficiency at the local level for conducting post-disaster damage assessments and regulating reconstruction activities to ensure compliance with NFIP substantial damage/improvement requirements | L | M | M | L | On-going |
| 4.1 | Develop and distribute a public informational pamphlet related to the potential health and safety implications of various natural hazard events. Also place the information on the internet and COMCAST. | M | L | L | L | S |
| 4.1 | Conduct hazard response practice drills and emergency management training exercises on an annual basis | H | L | M | L | On-going |
| 4.1 | Develop and implement a post-disaster recovery and mitigation training program for local officials | M | L | L | L | M |
| 4.1 | Establish a partnering relationship with the NWS to enhance the existing Flood Forecast and Warning System via the Advanced Hydrologic Prediction Services Program | H | M | L | L | S |
| 4.1 | Encourage the owners/operators of private schools and daycares to develop and implement an emergency response plan | M | L | L | L | M |
| 4.1 | Encourage local business and industry owners in known flood hazard areas to develop an emergency response plan as a potential alternative to implementing a physical property protection measure, where otherwise not technically or fiscally appropriate | H | M | L | L | M |
| 5.1 | Ensure municipal compliance with minimum NFIP floodplain development regulations | H | H | L | L | On-going |
| 5.2 | Prepare a power back-up plan for the county's critical facilities. Develop a regular maintenance program that includes a schedule to change filters, etc. | H | M | L | L | S |

| Goal/ Objective | Project Description | Life/ Safety Impact | Admin/ Legal Impact | Capital Costs | Oper./ Main. Costs | Time Frame |
|---|---|---|---|---|---|---|
| 5.2 | Conduct rigorous sampling and analysis of public and private drinking water supply sources immediately after an inundating flood event and issue boil water advisories as needed | H | H | M | M | S |
| 5.2 | Conduct engineering inspections of county fire stations to determine mitigation retrofitting measures necessary. | H | M | M | L | M |
| 5.4 | Coordinate with FEMA and the MEMA regarding updating Calvert County's, North Beach's and Chesapeake Beach's Flood Insurance Rate Mapping via FEMA's Flood Map Modernization Program to include the expansion of previously unmapped areas and additional Base Flood Elevations | H | M | H | L | L |
| 6.1 | Increase the number of NOAA Weather Alert radios in public places across the County | H | M | L | L | M |
| 6.1 | Make available for municipal use the digital natural hazard mapping files that were developed as part of this planning study | L | M | L | L | S |
| 6.1 | Enroll in the Firewise Communities Program | M | M | L | L | M |
| 1.2, 5.2 | Maintenance and replacement of critical bridges | H | M | H | M | L |
| 7.1 | Amend existing Comprehensive Plan to include an assessment of hazard vulnerability and appropriate mitigation recommendations | M | L | L | L | M |
| 7.1 | Revise existing Zoning Ordinance to include separate zones or districts for known hazard areas | M | H | M | L | L |
| 7.1 | Revise existing Subdivision Ordinance to include municipality-specific, hazard mitigation-related development criteria and/or provisions for the mandatory use of conservation subdivision design principles | M | H | M | L | L |
| 7.2 | Conduct a detailed inventory and prioritization of local environmental resources via the Comprehensive Planning or similar natural resources planning process | L | L | M | L | L |
| 7.2 | Update and implement a comprehensive water resources management plan that analyzes the County's existing water resources supply and evaluates the County's anticipated water use demand | L | L | M | L | L |

| Evaluation Element | Level of Impact | | |
|---|---|---|---|
| | L | M | H |
| Life/Safety | Minimal/negligible impact | Indirect impact | Direct impact on public safety |
| Administrative/Legal | Does not satisfy a legal or statutory requirement | Improvement on data collection and storage or admin process | Satisfies a statutory requirement/continuance of key functions |
| Capital Costs | <$50K | $50K to $250K | >$250K |
| Operating/Maintenance | <$15K | $15K to $30K | >$30K |

| Timeframe |
| --- |
| "S" indicated short range – action implemented within 1 year<br>"M" indicated medium range – action implemented between 2 and 5 years<br>"L" indicates long range – action implemented between 5 and 10 years |

## Mitigation Action Plan

Table 33 has been developed to summarize and prioritize the identified hazard mitigation measures. This table lists the prioritized mitigation actions, potential funding sources, and overall ranking of priority. The Planning Team prioritized these projects based on each jurisdiction's ability to fulfill the identified project-planning goals and their relative hazard mitigation/protection afforded. These projects were ranked by the Planning Team as being high-, medium-, or low-priority. Next the Planning Team ranked each of the projects and assigned 10 points for each "high" vote, 5 points for each "medium" vote, and 1 point for each "low" vote. In the event two or more mitigation measured resulted in a tie score, the measure with the most number of votes was ranked higher. The projects highlighted in yellow have been completed and/or are currently ongoing.

**Table 33: Mitigation Action Plan**

| Project ID | Project Description | Potential Funding source(s) | Responsible Entity | High | Med | Low |
|---|---|---|---|---|---|---|
| 1 | Prepare a power back-up plan for the county's critical facilities. Develop a regular maintenance program that includes a schedule to change filters, etc. | Coop with utility companies, county staff time. | General Services, Public Safety, Technology Services | X | | |
| 2 | Develop a new, or amend an existing, Comprehensive Plan to include an assessment of hazard vulnerability and appropriate mitigation recommendations | Calvert County CIP | County – Planning and Zoning<br>Local – Municipal Staff/Officials | X | | |
| 3 | Conduct routine inspections, regular maintenance, and annual tests on all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event | County/Town staff time | County EMA<br>Local | X | | |
| 4A | Ensure that a planned, coordinated, and effective public warning dissemination program exists at the local level | County/Town staff time | EMA | X | | |
| 4B | Develop a technical proficiency at the local level for conducting post-disaster damage assessments and regulating reconstruction activities to ensure compliance with NFIP substantial damage/improvement requirements | MEMA technical and training assistance | Municipal Staff/Officials | X | | |
| 4C | Increase the number of NOAA Weather Alert radios in public places across the county | HMGP, EMPG | EMA | X | | |
| 5 | Develop and distribute a public informational pamphlet related to the potential health and safety implications of various natural hazard events. Also place the information on the internet and COMCAST | Health Department, county staff time | Public Health, Public Relations Office with technical assistance | X | | |
| 6A | Conduct hazard response practice drills and emergency management training exercises on an annual basis | County staff time | EMA | X | | |
| 6B | Encourage uninsured property owners in known flood hazard areas to purchase flood insurance through the NFIP | FMA, HMGP, county staff time | Agency – FEMA/MEMA<br>County Public Relations Office<br>Local – Municipal Officials/Staff | X | | |
| 6C | Conduct a detailed inventory and prioritization of local environmental resources via the Comprehensive Plan or similar natural resources planning process | Calvert County CIP, EPA, CDBG | Municipal Officials/Staff with technical assistance | X | | |
| 6D | Develop and implement a post-disaster recovery and mitigation training program for local officials | Local staff time | EMA with technical assistance from MEMA/FEMA | X | | |
| 6E | Establish a partnering relationship with the NWS to enhance the existing Flood Forecast and Warning System via the Advanced Hydrologic Prediction Services Program | NWS technical assistance | County EMA with technical assistance | X | | |
| 6F | Work with local radio stations to promote continuity of public awareness and disaster preparedness. | County staff time, COOP with local radio stations | EMA | X | | |
| 7 | Coordinate with FEMA and MEMA regarding updating Calvert County's, North Beach's and Chesapeake Beach's Flood Insurance Rate Mapping via FEMA's Flood Map Modernization Program to include the expansion of previously unmapped areas and additional Base Flood Elevations | FEMA, MEMA, MDE | GIS, Planning and Zoning, EMA | | X | |
| 8 | Maintenance and replacement of county owned critical bridges | Calvert County CIP, SHA, MDOT | Engineering, Public Works | X | | |
| 9 | Conduct rigorous sampling and analysis of public and private drinking water supply sources immediately after an inundating flood event and issue boil water advisories as needed | Public Health | Public Health, Public Water Suppliers and Property Owners | X | | |
| 10A | Make available for municipal use the digital natural hazard mapping files that were developed as part of this planning study | County /Townstaff time | EMA | | X | |
| 10B | Conduct engineering inspections of county fire stations to determine mitigation retrofitting measures necessary | Calvert County CIP, FEMA technical assistance | County Engineer, Fire Rescue EMS | | X | |
| 10C | Encourage the owners/operators of private schools and daycares to develop and implement an emergency response plan | County staff time, COOP with schools and BOE | EMA<br>Local - Municipal Staff/Officials | | X | |
| 11A | Ensure municipal compliance with minimum NFIP floodplain development regulations | North Beach, Chesapeake Beach | Municipal Staff/Officials with technical assistance | | X | |
| 11B | Encourage local business and industry owners in known flood hazard areas to develop an emergency response plan as a potential alternative to implementing a physical property protection measure, where otherwise not technically or fiscally appropriate | County/Town staff time, MEMA technical assistance | Municipal Staff/Officials | | X | |
| 12 | Evaluate all manufactured homes to ensure their resistance to wind and flood hazards | Calvert County CIP, FEMA technical assistance | EMA, Inspections | | X | |
| 13 | Consider expanding the automated emergency alert community calling system (Code Red) | County/Town staff time | EMA and Technology Services | | X | |
| 14A | Develop a technical proficiency at the municipal level for assisting local residents and business owners in applying for hazard mitigation/assistance funds and identifying cost beneficial mitigation measures to incorporate into reconstruction activities | County staff time, EMI, technical assistance | EMA<br>Local - Municipal Staff/Officials | X | | |
| 15A | Ensure municipal compliance with local Stormwater Management Plans | North Beach,/Chesapeake Beach | Municipal Staff/Officials with technical assistance | X | | |

| Project ID | Project Description | Potential Funding source(s) | Responsible Entity | High | Med | Low |
|---|---|---|---|---|---|---|
| 15B | Store in an easily accessible location and make available for public inspection, the community's Flood Insurance Rate Mapping and associated Flood Insurance Study | County | County –Public Relations Office<br>Local – Municipal Staff/Officials | X | | |
| 16A | Ensure continued contractor compliance with approved Erosion and Sedimentation Pollution Control Plans and continue to work with local farmers to implement BMPs | County staff time | | | X | |
| 16B | Workshops for local engineers, architects and contractors/builders on IBC and hazard resistant construction | FEMA/MEMA technical assistance, county staff time | | | X | |
| 17 | Dry floodproof known flood-prone structures in accordance with the general guidelines | HMGP, FMA, PDM, CDBG | Joint effort between Municipal Officials/Staff and Local Property Owners | | X | |
| 18 | Store in an easily accessible location and make available for public inspection, this hazard mitigation plan and the FEMA guidance documents that were provided as part of the hazard mitigation planning program | County | County –Public Relations Office/<br>Local – Municipal Staff/Officials | | | X |
| 19A | Maintain natural hazard risk assessment and mitigation publications/materials at public libraries throughout the county | County | County Public Library System | | X | |
| 19B | Develop and distribute a public summary of this hazard mitigation plan including relevant information on hazard-prone areas, hazard specific "do's" and "don'ts" and emergency contact information | County | Public Relations Office | | X | |
| 19C | Develop a new, or revise an existing, Zoning Ordinance to include separate zones or districts for known hazard areas | County CIP | Planning and Zoning, Municipal Staff/Officials | | X | |
| 19D | Develop a new, or revise an existing, Subdivision and Land Development Ordinance to include municipality-specific, hazard mitigation-related development criteria and/or provisions for the mandatory use of conservation subdivision design principles | Calvert County CIP, North Beach, Chesapeake Beach | County –<br>Local – Municipal Staff/Officials | | X | |
| 19E | Preserve the highest priority undeveloped steep slope areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical steep slope areas may be preserved/protected via local ordinance | Land preservation grants | County –Parks Department<br>Local – Municipal Officials | | X | |
| 20 | Wet floodproof known flood-prone structures in accordance with the general guidelines | Homeowners, technical assistance from MEMA | Joint effort between Municipal Officials/Staff and Local Property Owners | | X | |
| 22 | Coordinate with the local municipality and/or the Department of Transportation on the potential feasibility of replacing, removing, or enlarging those bridge and culvert stream crossings that are unable to pass the 10-year frequency flood flow | Calvert County CIP, MDOT, SHA | County Commissioners and the Department of Transportation (DOT) | | X | |
| 23 | Preserve the highest priority undeveloped floodplain areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical floodplain areas may be preserved/protected via local ordinance | HMGP, FMA, CDBG, PDM | County –Parks Department<br>Local – Municipal Officials | | X | |
| 24A | Develop and implement a community-specific channel maintenance program consisting of routine inspections and subsequent debris removal | | Municipal Staff/Officials, CERT | | | X |
| 24B | Update and implement a comprehensive water resources management plan that analyzes the county's existing water resources supply and evaluates the county's anticipated water use demand | | MDE | | | X |
| 25A | Elevate known flood-prone structures in accordance with the general guidelines | HMGP, FMA, PDM, CDBG | Joint effort between Municipal Officials/Staff and Local Property Owners | | X | |
| 25B | Develop and implement a wetland protection program consisting of public education materials that highlight the functions and values of wetlands and local ordinance provisions that minimize/eliminate wetland disturbance | | | | X | |
| 26 | Relocate and/or acquire known flood-prone structures in accordance with the general guidelines | HMGP, FMA, PDM, CDBG | Joint effort between Municipal Officials/Staff and Local Property Owners | | X | |
| 27 | Preserve critical undeveloped forested areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical forested areas may be preserved/protected via local ordinance | Land preservation grants | Agency –Game Commission<br>County Parks Department<br>Local – Municipal Officials | | X | |
| 28 | Coordinate with FEMA, MEMA, NWS, and any other appropriate entities on developing and implementing a natural hazard awareness curriculum in local schools | Technical assistance | Public Relations Office with technical assistance from FEMA/MEMA | | | X |
| 28A | Enroll in the Firewise Communities Program | County staff time | Municipal Staff/Officials | | X | |
| 28B | Preserve high priority wetland areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical wetlands may be preserved/protected via local | Land preservation grants | County Parks Department<br>Local – Municipal Officials | | X | |
| 29 | Provide adequate shelters, with backup power, in various parts of the county to serve as refuge areas during floods and other hazard events | HMGP, FMA, PDM, CDBG | EMA, General Services, ARC, School Board | X | | |
| 30 | Ensure that all documented information can be accessible from the county internet/intranet site. Provide pertinent public information on COMCAST | County/Town Staff time | EMA and Technology Services | | X | |
| 31 | Follow the recommendations of the Chesapeake Bay Cliff Erosion Study Commission including the acquisition and relocation of willing property owners | FEMA/MEMA/County Staff Time | EMA with technical assistance from FEMA/MEMA | X | | |

# CHAPTER 8 – PLAN MAINTENANCE

## Overview

This section documents Calvert County and the participating jurisdiction's road map for maintaining the hazard mitigation program and instituting the long-term plan maintenance procedures into the everyday workings of the county government. A continuous cycle for monitoring, evaluating, and updating the plan; incorporating mitigation strategies into other, ongoing planning activities; methods for continued public involvement; and the establishment of the Planning Team are discussed below.

## Monitoring, Evaluating, and Updating the Plan

Monitoring, evaluating, and updating the plan are critical to maintaining its relevance. Effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. The Calvert County Hazard Mitigation Planning Team, under the direction of the Calvert County Emergency Manager Director, will monitor and evaluate the progress of the implementation of the mitigation strategies and update the plan on a regular basis.

The Planning Team will meet annually to address all its responsibilities. The Planning Team will monitor the mitigation activities by reviewing reports form the agencies identified for implementation of the different mitigation actions. The Planning Team will request that the responsible agency or organization submit a semi-annual report, which provides adequate information to assess the status of mitigation actions. The Planning Team would then provide their feedback to the individual agencies.

Evaluation of the plan should include not only checking on whether or not mitigation actions are implemented, but also assessing their degree of effectiveness. This would be done through a review of the qualitative and quantitative benefits (or avoided losses) of the mitigation activities. These would then be compared to the goals and objectives that the Plan was intended to achieve. The Planning Team would also evaluate mitigation actins to see if they need to be modified or discontinued in light of new developments. The Planning Team would document progress annually.

The Plan will be updated every five years, as required by the DMA 2000, or following a disaster. The Plan update will be led by the county's Division of Emergency Management, with participation by the town administrations. The updated Plan would account for any new developments in the county or towns or special circumstances (post-disaster). Issues that come up during monitoring and evaluation, which require changes in mitigation strategies and actions should be incorporated in the Plan at this stage. Throughout the hazard analysis and vulnerability assessment, descriptions of missing or inadequate data indicate some areas in which the county and municipalities could improve their ability to identify vulnerable structures. As the county and municipal governments work to increase their overall technical capacity and implement their comprehensive planning goals, they should also attempt to improve their ability to identify assets vulnerable to hazards.

## Implementation through Existing and On-going Programs

The Plan was adopted as an Annex to the Calvert County Emergency Operations Plan (EOP) which is administered through the Division of Emergency Management.

The Calvert County Comprehensive Plan and Capital Improvements Plan are currently being updated and the projects recommended under this mitigation plan will be incorporated into future amendments of these planning documents.

## Continued Public Involvement

The Planning Team will involve the public during the evaluation and update of this plan throughout the five-year implementation cycle. This will be accomplished by providing a hard copy of the plan to all appropriate agencies through the county and making copies available for public display as requested, including in the towns. In addition, the Planning Team will solicit public involvement through:

- Annual public education activities, public workshops, and public hearings.
- Continued representation by various citizen and homeowner associations on the Planning Team.
- Public meetings to solicit feedback and to obtain public input for plan evaluation.
- Public education via the county's website as a means of communication by providing information about mitigation initiatives, updates on the status of the mitigation measures, and recommended revisions to the mitigation plan.

## Hazard Mitigation Planning Team

A permanent entity will be responsible for maintaining the Plan and for monitoring, evaluating, and updating it. This plan recommends retaining the Hazard Mitigation Planning Team (with representation from all participating municipalities). The Committee will represent citizen, municipal, business, educational, volunteer and county interests through a balanced membership. A mitigation coordinator from the county's Division of Emergency Management would lead the committee.

The Planning Team will oversee plan maintenance during the five-year implementation timeframe. After the initial plan is finalized and adopted, the Planning Team will meet once per year to:

- Evaluate the effectiveness of previously implemented mitigation actions.
- Explain why any actions are not completed
- Identify any actual or perceived changes in risk or vulnerability
- Submit all revisions for adoption by all jurisdictions.

At the end of the five-year implementation, the Planning Team will oversee a major update to the plan that follows FEMA's planning guidance. The updated plan will be submitted to MEMA and FEMA for approval.

# APPENDIX A – Public Participation

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# CALVERT COUNTY HAZARD MITIGATION PLAN

**Hazard Mitigation Planning Team Meeting #1**
**March 15, 2011**
**3:00 pm – 4:30 pm**
**AGENDA**

| | |
|---|---|
| 3:00 pm to 3:20 pm | Introductions<br>o Calvert County Emergency Management<br>o Calvert County Planning Team<br>o Greenhorne & O'Mara Consultants |
| 3:20 pm to 3:45 pm | Presentation<br>o Planning Process<br>o Calvert County Hazard Identification<br>o Calvert County Risk Assessment |
| 3:45 pm to 4:15 pm | Discussion/Comments to Presentation<br>o Hazard Identification<br>o Risk Assessment<br>New information<br>o Existing Mitigation Measures<br>o Vulnerabilities<br>o Existing Capabilities |
| 4:15 pm to 4:30 pm | Wrap-up<br>Next steps<br>Schedule Planning Team meeting 2 & 3<br>Questions |
| 4:30 pm | Adjournment |

| Name | Agency/Affiliation | Email Address | Phone Number |
|---|---|---|---|
| Terry Cox | Dominion Cove Point LNG | Terry.L.Cox@dom.com | 410-286-2021 |
| Jane Yarchak | Calvert County Public Schs | [illegible] | 410-535-1600 ext 2267 |
| Greg Bailey | Planning/Zoning | bailegr@co.cal.md.us | 410 535-1600 ext 2352 |
| Betty Fenwick | Calvert County Emergency Mgt | fenwicbj@co.cal.md.us | 410 535 1600 x 2301 |
| Rick Clark | Calvert County Dept of Public Works | clarkrl@co.cal.md.us | 410 535-4720 |
| Carl Brown | CCEMA | brownce@co.cal.md.us | 410 535 1600 x2537 |
| Kelly McGuire | Maryland Emergency Management (MEMA) | kmcguire@mema.state.md.us | 443 518-9511 |
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# Calvert County NEWS

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*Board of Commissioners*
**Gerald W. Clark**
**Pat Nutter**
**Susan Shaw**
**Evan K. Slaughenhoupt Jr.**
**Steven R. Weems**

**FOR IMMEDIATE RELEASE**

**Date:** March 8, 2011
**Contacts:** Danita Broomchaisri, Marketing/Communications Specialist
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Mark Volland, Public Information Specialist
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**Public Invited to Participate in Hazard Mitigation Planning Workshop**

**PRINCE FREDERICK, Md. – March 8, 2011** – The Calvert County Hazard Mitigation Planning Team will review the planning process for addressing the local effects of various natural and manmade hazards during a stakeholders workshop Tuesday, March 15, 2011, 6:30 p.m. at the Courthouse Square Building, 205 Main Street, Prince Frederick.

Residents, elected officials, emergency responders and other interested stakeholders – especially those who may have been impacted by flooding or other hazards – are encouraged to attend. The purpose of the workshop is to present and discuss the planning team's approaches to updating the 2004 All-Hazards Mitigation Plan. The Hazard Mitigation Planning Team was created to steer the process and consists of representatives from town and county government departments, state and regional agencies and first responders.

The initial drafts of the updated 2011 All-Hazards Mitigation Plan identify the natural and manmade hazards to which local communities are vulnerable and update the quantitative assessment of the vulnerability for significant hazards such as flood and wind events. The public is encouraged to comment on these aspects of the plans at the workshop.

Prior to the workshop, the planning team will hold a work session at 5 p.m. that will be open to the public. For more information, contact Carl Brown in the Calvert County Department of Public Safety, Emergency Management Division, at 410-535-1600, ext. 2537 or e-mail brownclf@co.cal.md.us.

###

Calvert County Maryland Public Meeting
[illegible]

| Name | Agency Affiliation | Email Address | Phone Number |
|---|---|---|---|
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3/15/11

*Calvert County, Maryland*
*Hazard Mitigation Plan Update*
Comment Sheet

Please provide any comments you may have relating to the Calvert County Hazard Mitigation Plan Update to Bobby Fenwick with Calvert County Emergency Management by (175 Main St, Prince Fredrick) or mail your comments to:

**Greenhorne & O'Mara, Inc.**
**6110 Frost Place**
**Laurel, Maryland 20707**
**Attn: Stephen E. Smith, Calvert Co. Plan**

*Instructions*

1. Please be clear in your comments and refer to specific chapters and pages.
2. Please provide descriptive comments and ideas. Comments like "I don't like this" cannot be addressed.
3. If you have questions about anything in the plan, please speak with Bobby Fenwick of Calvert County Emergency Management at 410-535-1600.

Main Risks: Hurricane, Tornado, Ice storm, wild fire, flooding (shore roads)
How to Mitigate for Tornadoes?
Good Presentation.

# CALVERT COUNTY HAZARD MITIGATION PLAN

**Hazard Mitigation Planning Team Meeting #2**
**May 3, 2011**
**2:00 pm – 3:30 pm**
**AGENDA**

| | |
|---|---|
| 2:00 pm to 2:20 pm | Review of the Planning Process |
| 2:20 pm to 2:45 pm | Presentation<br>o Calvert County Vulnerability Assessment<br>o Loss Estimation<br>o Mitigation Strategies |
| 2:45 pm to 3:15 pm | Discussion/Comments to Presentation<br>o Vulnerabilities<br>o Mitigation Strategies<br>New Information<br>o Goals and Objectives<br>o Mitigation Actions |
| 3:15 pm to 3:30 pm | Wrap-up<br>Next steps<br>Schedule Planning Team meeting #3<br>Questions |
| 3:30 pm | Adjournment |

# MEETING SIGN-IN

► Calvert County, Mitigation Planning Team #2 ► May 3, 2011

| | NAME | TITLE | AGENCY | PHONE | FAX |
|---|---|---|---|---|---|
| 1 | CARL Brown | Emerg. Planner | | 410-535-1600 | |
| 2 | Wilson Foreland | Director GIS | | 410-535-1600 x2326 | |
| 3 | Robin Fenwick | Emerg Mgt Div Chief | | 410-535-1600 x2301 | |
| 4 | Kathleen O'Brien | GIS, Project Mgr | | 410 535 1600 | |
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CALVERT COUNTY HAZARD MITIGATION PLAN

Hazard Mitigation Planning Team Meeting #3
May 4, 2011
10:00 am – 11:30 am
AGENDA

| | |
|---|---|
| 10:00 am to 10:15 am | Mitigation Capability Assessment Matrix<br>• Discussion and/or completion |
| 10:15 am to 11:15 am | Goals and Actions<br>• Discussion<br>• Review/comments by municipalities<br>• Identification of Responsible Agencies<br>• Prioritization of Actions |
| 11:15 am to 11:30 am | Wrap-up<br>Next steps<br>Schedule Public Meeting<br>Questions |
| 11:30 am | Adjournment |

# MEETING SIGN-IN

► Calvert County, Mitigation Planning Team #3 ► May 4, 2011

| | NAME | TITLE | AGENCY | PHONE | FAX |
|---|---|---|---|---|---|
| 1 | CARL E BROWN | Emergency Manager | CCEM | 410-535-1600 | |
| 2 | Jim Parent | Town Administrator | Ches Beach | 410-257-2230 | |
| 3 | Terry Cox | Dominion Cove Pt LNG | Safety Specialist | 410 286 2021 | |
| 4 | Carey Bowen | Director | Dept. of Planning & Zoning | 410-535-1600 x2322 | |
| 5 | Wilson Freeling | Director | Dept. of General Services | 410-535-1600 x226 | |
| 6 | Robert Bowling | BOG Division Chief | " " " " | 410-535-1600 x2377 | |
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# Calvert County NEWS

175 Main Street
Courthouse
Prince Frederick, Maryland 20678
Phone: 410-535-4583 • 301-855-1880
www.co.cal.md.us

*Board of Commissioners*
Gerald W. Clark
Pat Nutter
Susan Shaw
Evan K. Slaughenhoupt Jr.
Steven R. Weems

**FOR IMMEDIATE RELEASE**

**Date:** September 13, 2011

**Contacts:** Danita Buonchristi, Marketing/Communications Specialist
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**Public Feedback Sought on Calvert County Hazard Mitigation Plan**
***Forum to Detail Plan for Reducing Risks of Damage from Natural Hazards***

**PRINCE FREDERICK, Md. – September 13, 2011** The Calvert County Department of Public Safety, Emergency Management Division, is hosting a public forum on updates to the county's Hazard Mitigation Plan on Thursday, September 29, 5:30-7:30 p.m. at Courthouse Square, 205 Main Street, Prince Frederick.

The forum will detail the plan and allow public comment on the county's ongoing hazard mitigation program. The goal of the program is to permanently reduce or eliminate long-term risks to people and property from the effects of natural hazards such as tornadoes, floods, hurricanes, severe storms, droughts, landslides and other events.

Calvert County's Hazard Mitigation Plan identifies and assesses potential natural hazards, evaluates local mitigation measures that should be undertaken and outlines procedures for monitoring the implementation of mitigation strategies.

A draft of the plan can be viewed online at www.co.cal.md.us/assets/HMPUpdate2011.pdf and is also available at local libraries. For more information on the Calvert County Division of Emergency Management, visit online at www.co.cal.md.us or call 410-535-1600, ext 2638.

*###*

*Calvert County is Maryland's smallest county in land area with 212 square miles. It is home to approximately 92,000 people and has one of the highest standards of living in Maryland. Major industries include defense contracting, information technology, tourism, utilities, light manufacturing and administrative services.*

Southern Maryland News Net
smnewsnet.com

ABC
23741 THREE NOTCH RD. CALIFORNIA, MD 20619



# Public Feedback Sought on Calvert County Hazard Mitigation Plan

[illegible]

[illegible] Thursday, September [illegible] Courts, 205 Main Street, Prince Frederick.

The County is [illegible] the County's natural hazard mitigation [illegible]. The goal of the program is to [illegible] people and property from [illegible] natural disasters, such as hurricanes, [illegible] storms, tornadoes, and other events.

Calvert County's Hazard Mitigation Plan identifies and assesses potential natural hazards, evaluates vulnerabilities to such hazards, and outlines procedures for monitoring the implementation of mitigation strategies.

[illegible] the draft online at [illegible] 2011.pdf and video [illegible] Hazard Mitigation Plan [illegible] Calvert County [illegible] Planning & Zoning [illegible] www.calvertcounty.com or call (301) 855-8020 or [illegible]

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Leave a Reply

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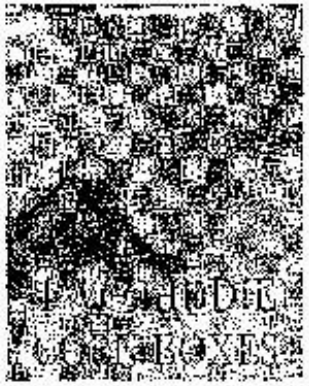

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# MEETING SIGN-IN

▶ Calvert County, Public Meeting #2

▶ September 29, 2011

| | NAME | TITLE | AGENCY | PHONE | FAX |
|---|---|---|---|---|---|
| 1 | C. Michaelopoulos | | – | 410-394-4192 | |
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# APPENDIX B – Calvert County Flood Mitigation Plan

# Flood Mitigation Plan
## Calvert County, Maryland

**August 2, 2011**

**Prepared for:**

Calvert County Department of Planning and Zoning
County Services Plaza, 150 Main Street
Prince Frederick, MD 20678

**Acknowledgments**

This Flood Hazard Mitigation Plan was prepared under the guidance of the County's Department of Planning and Zoning and the Hazard Mitigation Steering Committee. The members of the Steering Committee are listed in Chapter 1.

This Plan was funded by a Flood Mitigation Assistance (FMA) grant from FEMA and administered through the Maryland Emergency Management Agency (MEMA).

The Plan was prepared by:

| | |
|---|---|
| Vision Planning and Consulting, LLC<br>8575 Window Latch Way<br>Columbia, MD 21045<br>Contact: Deepa Srinivasan, AICP, CFM<br>Phone: 240 893 8719<br>Fax: 480 393 5396<br>Email: dsrinivasan@vision-pc.net | Eastern Shore Regional GIS Cooperative<br>Salisbury University<br>1101 Camden Ave<br>Salisbury, Maryland 21801<br>Contact: Dr. Michael Scott<br>Ph: 410.543.6456<br>Fax: 410.548.4506<br>msscott@salisbury.edu |

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# CHAPTER 1: INTRODUCTION

## Background

Floods are a common occurrence throughout the United States and result from large-scale weather systems that generate rainfall or on-shore winds for prolonged periods. Other causes of flooding include local thunderstorms, snowmelt, ice jams, and dam failures. Flash-floods are characterized by high velocity waters that carry large amounts of debris.

Over the years, communities throughout the country have taken proactive measures to reduce the impact of flooding and the damage caused by it to residents and structures. In May 2007, Calvert County received funding from (FEMA) through the Flood Mitigation Assistance (FMA) grant for the development of a Flood Mitigation Plan for the County. The purpose of the Plan was to address flood hazards that threatened the health and welfare of the County and develop actions to mitigate the effects of flooding.

In September 2008, the County hired consultants Deepa Srinivasan, President of Vision Planning & Consulting, and Dr. Michael Scott, Director of the Eastern Shore Regional GIS Cooperative at Salisbury University to assist the County with the preparation of their Flood Mitigation Plan.

The overarching goal of this project was to *"To develop a flood mitigation plan to improve Calvert County and its municipalities' resistance to floods by identifying actions to reduce the impact of floods to county residents and structures.*

## Study Area

Calvert County is located in southern Maryland approximately 30 miles southeast of Washington DC. The County is a peninsula and is bordered by the Chesapeake Bay in the south and east while the western shore is bounded by the Patuxent River. There are two incorporated towns in the County and both are located along the Chesapeake Bay: Chesapeake Beach, incorporated in 1886, and North Beach, incorporated in 1910. There are seven designated "town centers" within the county, including Prince Frederick, the county seat. Others include Dunkirk, Huntingtown, Lusby, Owings, St. Leonard, and Solomon's Island. In 2010, the population of Calvert County was 88,737[1], and the total number of households was 31,299.

Calvert County has a generally mild climate with four distinct seasons and mild temperatures. On average, 43.1 inches of precipitation fall annually. Snowfall averages 19.4 inches annually. [2]

The topography in Calvert County is varied. An upland plain runs the length of the County from the northwest to the southwest. The land is more rugged on the east side of the plain, ending in sharp cliffs, while the west side is marked by down sloping land toward the Patuxent River that is good for farming. This plain also divides the

[1] US 2010 Census of Population and Housing

[2] Maryland State Office of Climatology

watersheds into the Lower Western Shore and the Patuxent River watersheds. The elevation ranges between sea level and 168 feet throughout the County.

The flood threats include riverine flooding from the tributaries of the Patuxent River and coastal flooding from the Chesapeake Bay. Riverine flooding sources include the Patuxent River itself, Hall Creek, Hunting Creek, Battle Creek, St. Leonard Creek, Back Creek, and Mill Creek (Figure 1.2)

**Figure 1.1 Regional context of the study area**

## Flooding History

Calvert County has had numerous incidents of flooding, including a couple major events such as Hurricane Hazel in 1954, Hurricane Floyd in 1999, and Hurricane Isabel in 2003. Most incidents are the result of storm surges from tropical systems, tidal flooding from either nor'easters, or a combination of landward winds and astronomical high tides, and flash flooding from sudden, short-lived rainstorms. Many references were found for Calvert County when researching the history of floods in the region, and it is reasonable to assume that this is just a selection of flood events. The sources for these flood history narratives include the Flood Insurance Study for Calvert County and the National Climatic Data Center who maintains a national database of storm events, including flooding, from 1950 to 2008. A search of that database yielded 16 flood events in Calvert County, beginning in 1993.

**Figure 1.2 Flooding sources and study area context**

*October 1954 – Hurricane Hazel*

On October 21st, 1954, Hurricane Hazel hit Calvert County. The Solomons and North Beach areas of the county were affected the most by the damaging tides, which were six to eight feet above the normal tidal range. The hurricane caused thousands of dollars worth of damage to barns, tobacco plants, businesses, and residential homes. Despite sustained winds over 100 miles per hour and extreme tides, there were only three injuries and zero casualties. The injures were kept to a minimum for good reason, the citizens stood ready to help wherever they could, "It is indeed gratifying to know that during such an emergency our citizens unconcerned for their own safety worked in the truly American way-'One for All, and All for one'" (Calvert Independent, October 21, 1954).

*August 13-17, 1955 – Hurricane Connie*

Hurricane Connie struck Calvert County on August 18, 1955, reminding many of her predecessor, Hazel. The Hurricane caused widespread damage with flooding occurring along the Chesapeake Bay and Potomac; this was caused but the storms heavy rainfall, over 9.5 inches, and the above normal tides. The flooding filled many wells and caused extensive damage to homes, specifically filling basements. There were at least 12 known deaths directly related to the storm's damage on land and 14 people lost their lives when the Levin J. Marvel, a large schooner was wrecked by the storm. During the peak of the storm, a few local fishermen braved the storm in a 14' boat and saved six of the Marvel's survivors.

*October 3, 1971 – Thunderstorm*

A strong thunderstorm blew through the Calvert area causing flooding, road closings and power outages. Route 261 was completely flooded due to the effects of the storm. The storm resulted in approximately $50,000 of crop damage and $10,000 of property damage.

*September 5, 1979 – Tropical Storm David*

Tropical storm David moved through the Calvert area on September 5, 1979, resulting in damage of over two million dollars. The major flood damage was confined to the northern portions of the county, especially the low-lying twin beach area. The Kenwood beach area was hit with over six inches of rain, which caused collapsed retaining walls, flooded basements, and washed out roads in and around the development. A SMECO employee was killed instantly when he and a co-worker came into contact with a live power line on Mackall Road; the men were working to restore power to the Wallville area.

*November 4, 1985 – Thunderstorm*

On Wednesday, November 4, 1985, a severe thunderstorm brought rain, wind, and high tides to the Calvert area. There were four foot waves battering the shoreline and tides of three to four feet above normal; this caused many residents of low lying areas to evacuate. The flooding damaged businesses, homes, roads, and piers, many places were still flooded two days later which delayed damage reports. The major damage occurred around North beach, along Atlantic Avenue where decks and porches were ripped from their foundations. The Chesapeake beach area sustained less damage than the North Beach area, but was flooded for days after the storm. Most of the damage was confined to North Beach, Chesapeake Beach, Broomes Island, Neeld Estates, Willows Colony, Kenwood Beach, Long Beach, and Cove Point, with damages in excess of 1.5 million dollars dollars. Approximately 150 homes affected by the storm, 2,500 feet of seawall was destroyed, and the estimated road damage was over $30,000.

*September 6, 1996 – Hurricane Fran*

On September 6, 1996, Tropical Storm Fran passed through Maryland just west of Calvert County. The hardest hit areas of the county were North Beach, Breezy Point,

Hallowing Point and Broomes Island. High winds and surging tides brought flood damage to many homes in these areas. There were at least 60 residences which sustained flood damage, the worst hit were three homes on Annapolis Avenue in North Beach and four apartments in Hallowing Point. In addition to residential damage, many roads in Solomon's Island were flooded. The damage for the Calvert area was estimated at $750,000.00.

*January 28, 1998 – Nor'easter*

A fairly intense and slow-moving nor'easter produced a large area of moderate to heavy rains across the central and lower portion of southern Maryland beginning on 27 January and continuing through late afternoon on the 28th. Rain totals ranged from 3 and 4 inches. Widespread minor to moderate flooding of small streams, creeks, and low-lying areas occurred over much of lower southern Maryland. Though no coastal flooding was observed, there was some minor overwash at Chesapeake Beach and two homes sustained minor damage from fallen trees.

*February 4 - 5, 1998 – Nor'easter*

A powerful nor'easter, carrying copious moisture from the Gulf of Mexico and Caribbean region, dumped between 3 to 5 inches in lower southern Maryland, causing widespread flooding of low lying areas and small streams and creeks. The nor'easter, coming on the heels of one just a week earlier, caused tides of 3 to 4 feet above normal from Solomons Point to North Beach. Local officials in North Beach noted that up to one-half of the beach was pushed southward by the pounding waves; an outfall was trapped open by the action of the shifting sand, causing water from the bay to inundate local roads and some establishments. The degree of erosion was greater than that associated with the remnants of hurricane Fran in 1996.

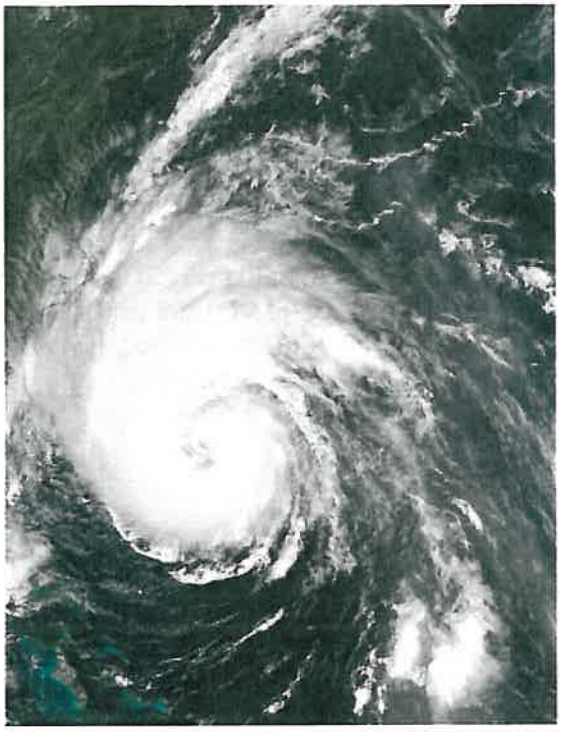
*September 16, 1999 – Hurricane Floyd*

The eye of Hurricane Floyd passed east of the Chesapeake Bay on 16 September 1999. Gusty winds of 30 to 50 MPH blew across the area resulting in 5-12 inches of rain across Calvert County. The degree of damage Calvert County received from the storm enabled the county to qualify for FEMA disaster assistance. Tidal flooding was reported along the Chesapeake Bay. Strong southerly winds ahead of the hurricane pushed tides 2 to 3 feet above normal, flooding several low lying areas. Numerous shoreline homes between 2 and 4 feet above sea level were flooded. In Calvert County, hundreds of large trees were downed onto roads, homes, and power lines. Over 11,000 electrical outages were reported. Winds gusted to 69 MPH at Mid Bay buoy offshore of Calvert Cliffs.

*September 2, 2000 – Thunderstorm*

Several roads in the northern portion of the county were flooded. Slow moving thunderstorms produced heavy rainfall and damaging lightning across portions of central Maryland on September 2nd. Law enforcement officials reported cars floating off Mt. Harmony Road after water rapidly rose. Route 4 and 260 and roads in Dunkirk, Owings, and North Beach were also inundated by water. A total of 1.25 inches of rain was reported in Dunkirk where lightning strikes damaged two homes and a fire station.

**Figure 1.3 Hurricane Isabel; September, 2003 (Source: NOAA)**



*September 19 – 21, 2003 – Tropical Storm Isabel*

Tropical Storm Isabel raged through Maryland, hitting Calvert County on September 18th, 2003. The storm surge that came with Isabel was five to nine feet above normal. In North Beach, a house was moved off of its foundation, the pier at Solomon's Island was completely demolished, and much shoreline was lost. Approximately 22,400 customers were left without power in the county and the hospitals were seeing an additional 130 patients per day. Over 100 homes sustained major damage and a few were completely destroyed. Residents who had lived in the area for 80 years felt that Isabel caused more damage than the 1933 Hurricane, which created the Ocean City Inlet.

*June 26, 2006 – Thunderstorm*

Scattered areas of flash flooding began on June 23 and continued into June 24. Then, flooding began to take on a more serious nature on June 26 since the ground had become saturated in so many spots. A mudslide occurred on B Street near the boardwalk in Chesapeake Beach. As a result, double digit rainfall totals affected parts of the region during the previous five days.

*September 1, 2006 – Tropical Depression Ernesto*

Tropical Depression Ernesto brought high winds and heavy rain to the Calvert area on September 1st, 2006. Ernesto also had a hand in affecting the purity of the Chesapeake Bay; during the storm the Chesapeake wastewater plant released approximately 1.5 million gallons of wastewater into the Chesapeake Bay. Many trees were uprooted during the storm's rage including an historic red oak in Dunkirk.

*May 11-12, 2008 – Thunderstorm, High tide*

**Figure 1.4 Flooding on Ninth Street in North Beach, May 12, 2008. (Source: Washington Post)**

Calvert County was hit hard with heavy rain and flooding during May 11th and 12th, 2008; rainfall totaled over 4 inches. This coupled with high tides caused flood damage to many residential buildings. The North Beach area was hit the hardest by flooding, where cars that were parked on Bay Avenue were partially submerged, and Route 261 in North Beach was impassable due to the flood waters (Figure 1.4). In the Long Beach area, a few houses were battered by surging waves late Sunday night into Monday morning. The Hallowing Point Trailer Park had to be evacuated due to the Patuxent River's rising waters.

## Plan Objectives

This Flood Mitigation Plan for the County fulfills the following objectives:

- It is consistent with the requirements of the 44 Code of Federal Regulations part 78.5 - Flood Mitigation Plan Development in accordance with the National Flood Insurance Act of 1968 (42 U.S.C. 4104c et seq.);
- It conforms to all pertinent criteria and regulations, including those found in applicable state and local ordinances and NFIP requirements;
- It identifies risks from flood and mitigation strategies for Calvert County and its two municipalities;
- It helps reduce the risk of loss of life, personal injury and property damage to the County's residences and businesses; and
- It will be submitted to MEMA and FEMA for approval, opening the way for future federal funding of flood mitigation projects.

## Planning Approach

The Flood Mitigation Plan for Calvert County has been developed in compliance by the 44 Code of Federal Regulations (CFR) 78.5 Flood Mitigation Plan Requirements. This Plan:

- Describes the planning process;
- Describes public involvement;
- Includes existing flood risk;
- Includes the number of estimated structures in floodplain;
- Identifies repetitive loss structures;
- Identifies the extent of flood depth and damage potential;
- Discusses floodplain management goals;
- Identifies and evaluates feasible mitigation actions;
- Presents a strategy for reducing flood risks;
- Provides a strategy for continued compliance with NFIP;

- Describes procedures for ensuring implementation, reviewing progress, and making revisions; and
- Provides documentation of Plan by legal authority.

## Flood Mitigation Plan Participants

The planning process involved a number of entities at the local, state, and Federal level:

- Hazard Mitigation Steering Committee members (Calvert County and municipal staff) – attendance at meetings and review of plan materials;
- Consultants – Vision Planning and Consulting, and Eastern Shore Regional GIS Cooperative – assessment of flood risk, development of mitigation actions, plan preparation and meeting facilitation;
- Public – plan input
- Maryland Emergency Management Agency (MEMA) – plan review and approval
- Federal Emergency Management Agency (FEMA) – project funding and plan review and approval.

## Hazard Mitigation Steering Committee

A Hazard Mitigation Steering Committee (HMSC) was formed to serve as the committee for this planning process. The HMSC members participated in all committee meetings, and provided input on the issues to the consultants. Table 1.1 lists the members of the Hazard Mitigation Steering Committee and the agencies they represent.

**Table 1.1 Hazard Mitigation Steering Committee members**

| Name | Title | Agency |
|---|---|---|
| Carl Brown | Emergency Planner | Emergency Management |
| Dave Brownlee | Principal Environmental Planner | Planning & Zoning |
| Ron Clark | Engineering Bureau Chief | Public Works |
| Mary Beth Cook | Deputy Directory / Department of Planning and Zoning | Planning & Zoning |
| Bobby Fenwick | Division Chief | Emergency Management |
| Joe Hawxhurst | Division Chief | Inspections & Permits |
| John Hofmann | Town Engineer | Town of North Beach |
| John Knopp | Project Engineer / Plan Review | Public Works |
| Steve Kullen | Environmental Planner: Watershed / Grants | Planning & Zoning |
| Barbara Mason | Resident: Cove Point Beach | Citizen-at-Large |
| Dawn Mister | Permit Coordinator | Inspections & Permits |
| Mieke Rockhill | Resident: Long Beach | Citizen-at-Large |
| Mike Scott | Consultant | Consulting Team / ESRGC |
| Deepa Srinivasan | Consultant | Consulting Team / Vision |
| John Swartz | Environmental Planner: Critical Area / Permit Review | Planning & Zoning |
| Marjorie Tuttle | Resident: Cove Point Beach | Citizen-at-Large |
| Bill Watson | Engineer | Town of Chesapeake Beach |

## Planning Process

The planning process comprised of four main steps: 1) organizing work group and process; 2) assessing the flood hazard, vulnerability, and mitigation capability; 3) developing a mitigation plan; and 4) implementing the plan. These steps are elaborated in the sections below.

### *Step 1 – Organize work group and process*

A Hazard Mitigation Steering Committee was formed by the County's Department of Planning and Zoning that included staff representatives from various County and City agencies, and stakeholders from the flood-prone areas. The Consultants worked closely with the Hazard Mitigation Steering Committee and met with them four times during the planning process.

**Figure 1.5 Calvert County Hazard Mitigation Steering Committee**

The first Steering Committee meeting was held on November 13, 2008 at the Calvert County Government Building in Prince Frederick. At this meeting, the planning process, key elements of the Plan, schedule, and deliverables were discussed. A mitigation capability assessment questionnaire was also distributed to the Steering Committee for input on plans and ordinances and the County's capabilities with respect to flood mitigation.

The second Steering Committee meeting was held on March 31, 2009 at the Calvert County Government Building. At this meeting, the data on the flood hazard identification was presented; input on the flood risk was solicited; and the data from the hazard vulnerability and risk assessment was discussed.

At the third Steering Committee meeting held on April 23, 2009 at the Calvert County Government Building, the highlights of the mitigation capability assessment were presented and an exercise to develop goals and objectives was conducted. At this meeting, a range of mitigation actions were examined that addresses the Plan's goals.

The fourth and final Steering Committee meeting was held on June 4, 2009 at the Calvert County Government Building. At this meeting, mitigation alternatives were discussed and prioritized, along with an implementation strategy for each action. A plan maintenance schedule was also developed at this meeting.

*Public Involvement*

In this planning process, public involvement assumed various forms. First, county and municipality residents were encouraged to provide input through representatives on the Mitigation Steering Committee. Residents in flood-prone areas were also invited to attend meetings and provide their comments and concerns.

Second, public input was solicited at two public meetings during the planning process. The first public meeting was held at Court House Square in Prince Frederick on April 30, 2009. At this meeting, the planning process and the results of the hazard identification were

presented to the public. The group discussed the community's risk to flooding in specific areas and offered suggestions for mitigation actions. A public notice was published in the local newspaper, the Calvert Recorder. Approximately 15 people attended the public meeting.

The second Public Meeting was held at the Calvert Pines Senior Center on West Dares Beach Road in Prince Frederick on June 16, 2009. At this meeting, mitigation goals and objectives along with actions were presented for review and discussion. A public notice of this meeting was published in the local newspaper, the Calvert Recorder (included in the Appendix). Copies of the draft plan were available for review during this meeting. A public forum was held on June 16, 2011 also at the Calvert Pines Senior Center. At this meeting, the Draft Flood Mitigation Plan was presented and comments received. Public Hearings are scheduled for July 20, 2011 before the Calvert County Planning Commission and July 26, 2011 before the Board of County Commissioners of Calvert County.

Third, a mitigation capability questionnaire was developed and distributed to the Steering Committee members. The purpose of the questionnaire was to solicit input on critical facilities, existing plans and ordinances and flood-related policies, and mitigation projects that have been implemented in the past.

***Step 2 – Assess hazards, risks, vulnerability, and mitigation capability***

In this step, information on past flood events in the County was gathered and areas where flooding is an issue, were identified. This step also involved a literature review of publications addressing historical flood events, an internet search for data related to historic events, and an inventory and review of the existing GIS layers and other documentation pertinent to the County. The vulnerability analysis included estimates of potential losses, types and numbers of existing and future at-risk buildings, infrastructure, and critical facilities located in the identified hazard areas. This is addressed in detail in Chapter 2. The Mitigation Capability Assessment included a review and analysis of the County's plans, ordinances, programs, and policies in light of flood mitigation and floodplain management. This section also included an analysis of the County's programs and policies, and their capability to adequately address the flood threats.

***Step 3 – Develop a mitigation plan***

Based on flood hazard data and the vulnerability and capability assessments, mitigation goals and objectives were developed. These goals were aimed at protecting the community from long-term vulnerability to the identified flood hazards. A comprehensive range of specific mitigation actions and projects to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure, were developed in this step.

The Plan explored various categories for mitigation actions. Examples of the types of projects in each of these categories are included below:

- Preventive measures – e.g., zoning, floodplain management, stormwater, and other ordinances;
- Structural projects – e.g., levees, reservoirs, channel improvements;

- Property protection measures – e.g., relocation, flood-proofing, flood insurance;
- Emergency services – e.g., warning, sandbagging, evacuation;
- Natural resource protection – e.g., wetlands protection, best management practices; and
- Public information – e.g., outreach projects, technical assistance

Each of these categories is discussed in detail in Chapters 3 through 8 in the report.

### *Step 4 – Implement the Plan*

An Action Plan was developed that described how the mitigation strategies and activities identified would be prioritized, implemented, funded, and administered. Cost estimates for the recommended projects, where available, and funding sources to implement recommended projects were identified. A description of the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle and also ways to incorporate community participation into the plan maintenance process was included in the final section of the Plan.

## Organization of the Report

The Calvert County Flood Mitigation Plan is comprised of 9 chapters. Chapter 2 identifies the sources of flooding and assesses the County's vulnerability to flooding; Chapter 3 elaborates on preventive measures; Chapter 4 focuses on property protection techniques; Chapter 5 discusses emergency services; Chapter 6 identifies structural projects; Chapter 7 examines natural resources protection techniques; Chapter 8 identifies options for public outreach. Chapter 9 identifies goals and objectives for the plan and includes actions to mitigate the flood hazard. The final chapter includes the criteria for ranking flood mitigation projects; identifies top-priority projects; and outlines a process for plan update and maintenance.

# CHAPTER 2: PROBLEM DESCRIPTION

Flooding occurs when rivers, creeks, streams, ditches, or other water bodies receive more water that they can handle from rain or snowmelt. The excess water flows over adjacent banks into the adjacent floodplain. As many as 85 percent of the natural hazard disasters across the United States have been attributed to flooding.

This Chapter outlines the scope of Calvert County's flooding problems including the sources of flooding, the 100-year flood levels in each of Calvert County's waterways, the hazards that could be expected from a flood, and the type and degree of damage a flood could cause. However, the primary focus of this Chapter is to present the results of the flood vulnerability assessment including potential damage amounts, probable locations of flooding in a 100-year event, and an accounting of the critical facilities exposed to the flood hazard.

## Sources of Flooding

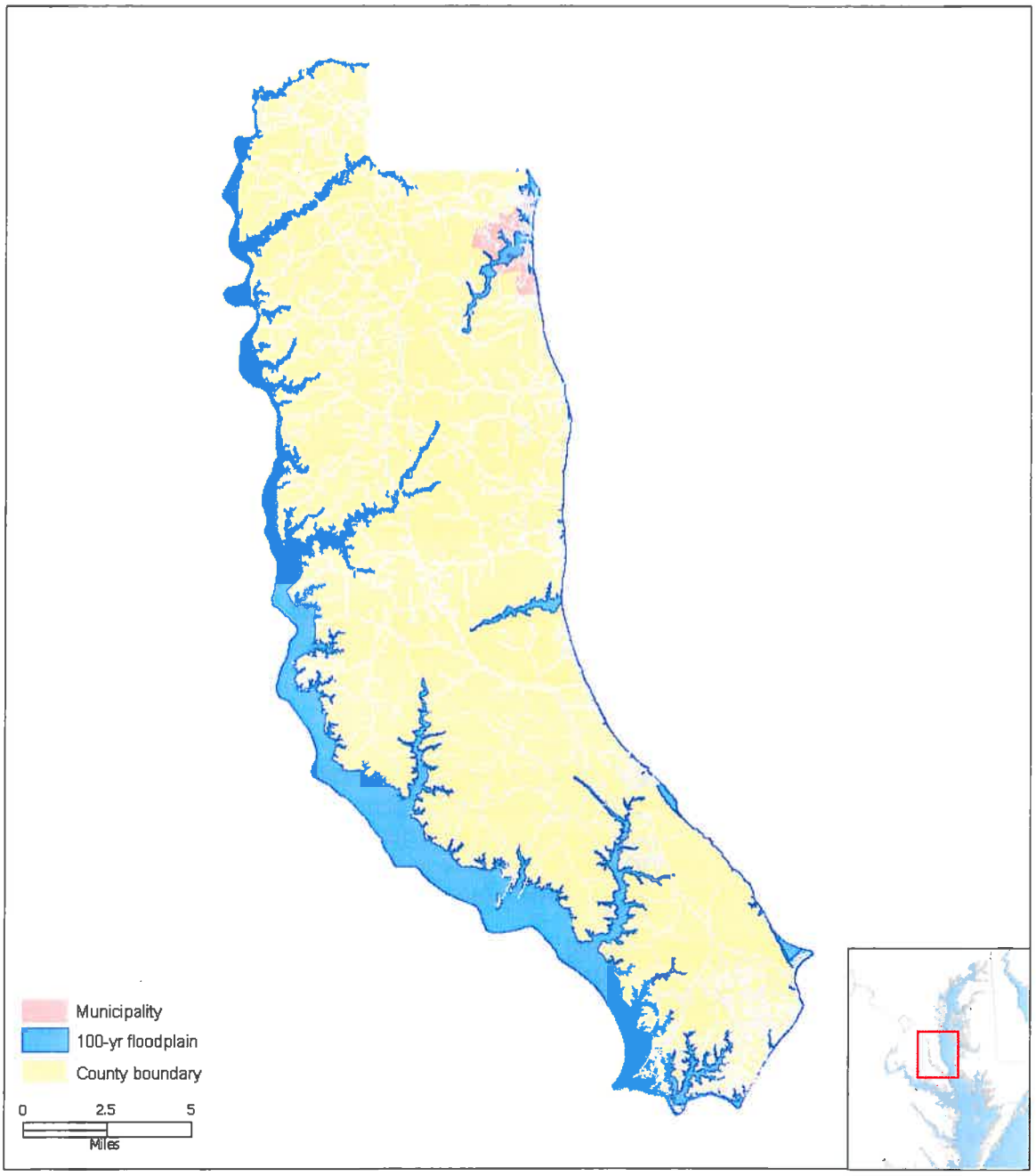
In Calvert County, flood origins include riverine flooding from the tributaries of the Patuxent River and coastal flooding from the Chesapeake Bay. Riverine flooding sources include the Patuxent River itself, Hall Creek, Hunting Creek, Battle Creek, St. Leonard Creek, Back Creek, and Mill Creek.

### *Riverine and Tidal Flooding*

The following map (Figure 2.1) depicts the 100-year floodplains within Calvert County, as designated by FEMA on the Flood Insurance Rate Maps or FIRMs. The 100-year flood is a flood which has a 1 percent chance of being equaled or exceeded in any given year (MDE, *Maryland Floodplain Manager's Handbook*). Calvert County can experience riverine flooding as a result of excessive rainfall in a matter of hours, such as from a severe thunderstorm. Additionally, some soils can become saturated over a longer period of time and reduce their absorption potential. Riverine flooding can affect any of the rivers and streams in the County but primarily affects the non-tidal or brackish portions of the streams that feed the Patuxent River. Tidal flooding in Calvert County usually occurs as a result of tropical storms (including hurricanes) as well as the combination of high astronomical tides with a northeast wind.

It is evident (Figure 2.1) that the floodplains impact many parts of Calvert County. In fact, 7.6 percent of the County's land area is in the 100-year floodplain. Given the exposure of the County to the water, one would expect this percentage to be higher. Fortunately, much of the central to southern coastline of Calvert County is in the form of a significant scarp, keeping it safe from flooding. The floodplain is defined as the area adjoining a river or stream that has been or may be covered by floodwater (Figure 2.2). This is different than the floodway, defined as the channel of a river or stream and the parts of the floodplain adjoining the channel that are reasonably required to efficiently carry and discharge the floodwater or flood flow of a river or stream. Encroachments in the floodway cause increased flood elevation, both upstream and downstream. Unfortunately, the FIRMs do not depict the floodway as a separate area.

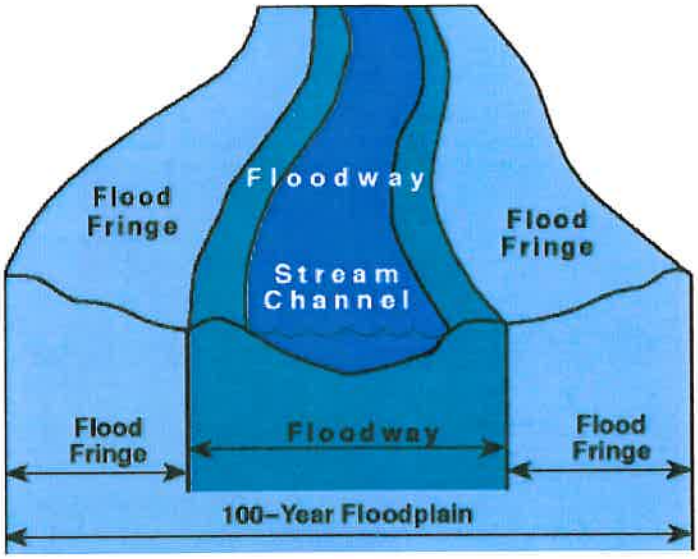
**Figure 2.1 Calvert County 100-yr floodplain from FIRMs**



### *Dam Failure*

Dams are water storage, control, or diversion barriers that impound water upstream in reservoirs. Dam failure is a collapse or breach of the structure. While most dams have storage volumes small enough that failures have little or no repercussions, dams with large storage volumes can cause significant flooding.

**Figure 2.2 Schematic of a floodplain (Source: Ohio Dept of Natural Resources)**




### *Storm water Flooding*

Another source of flooding in Calvert County is stormwater system overflow, resulting from a large amount of precipitation in a short period of time. This type of flooding occurs much more often than riverine flooding, but the impacts are often localized and minimal. Most of these more-frequently flooded locations are within the built-up areas and known to the county and municipal staff.

### *Flood Measurement*

There are no active US Geological Survey gauging stations within the County. Only one National Weather Service Advanced Hydrologic Prediction Service hydrographs exists in the County (Table 2.1). The measurements of stream discharge, river stage, and tide height are critical to the prediction of flood events. While recording the water level, the SLIM2 hydrograph does not list flood levels or level prediction

**Table 2.1 Hydrographs in Calvert County**

| Agency | ID Number | Station Name | Real-Time or Daily |
|---|---|---|---|
| NWS | SLIM2 | Chesapeake Bay at Solomons Island | Real-time |

### *Flood Levels*

Using the Flood Insurance Studies (FIS) of Calvert County, Chesapeake Beach, & North Beach, the following tables (Tables 2.2 and 2.3) report the flood elevations and discharge amounts for the key flooding sources. Normally, these numbers would be used without question in the modeling of the potential flood depth. However, when the coastal flood elevations were compared to the actual storm surge measurements from Hurricane Isabel (a 75- or 80-year storm), it was found that the flood elevations were significantly underestimated. In order to create a more realistic estimate of flood depths, the flood elevations from the 2006 US Army Corps of Engineers' Sea, Lake, and Overland Surge from Hurricanes (SLOSH) model results of the Chesapeake Bay. Using these flood elevations add a modicum of uncertainty to the results because they are modeled estimates, the results are much more realistic than if the obviously incorrect FIS elevations were used.

**Table 2.2 Peak discharges and flood elevations for 100-year riverine event (Units are NAVD 1988 feet)**

| Flooding Source | Drainage Area | 100-year Peak Discharge (CFS) | 100-year Flood Elevation |
|---|---|---|---|
| Hall Creek @ Patuxent River | 13.85 | 4,701 | 7.2 |

**Table 2.3 Flood elevations for 100-year coastal event (Units are NAVD 1988 feet)**

| Flooding Source | 100-year Flood Elevation from FIS | 100-year Flood Elevation from SLOSH |
|---|---|---|
| Chesapeake Bay @ north county boundary | 5.3 | 8.2 |
| Chesapeake Bay @ Randle Cliff Beach | 5.3 | 8.1 |
| Chesapeake Bay @ Plum Point | 5.2 | 8.0 |
| Chesapeake Bay @ Dares Beach | 5.0 | 8.0 |
| Chesapeake Bay @ Calvert Beach | 4.8 | 7.5 |
| Chesapeake Bay @ Cove Point | 4.4 | 7.3 |
| Chesapeake Bay @ Drum Point | 4.7 | 7.6 |
| Patuxent River @ Chesapeake Bay | 4.7 | 7.7 |
| Patuxent River @ St. Leonard Creek | 5.2 | 8.1 |
| Patuxent River @ Battle Creek | 5.8 | 8.9 |
| Patuxent River @ US 231 | 6.2 | 9.3 |
| Patuxent River @ Holland Drive | 6.8 | 11.0 |
| Patuxent River @ Hall Creek | 7.2 | 12.3 |
| Patuxent River @ Lyons Creek | 7.5 | 12.3 |

### *Hazards from Floods*

Flooding causes $6 billion in average annual losses in the United States annually and account for an average of 140 casualties annually (USGS, "Flood Hazards – A National Threat," 2006). While most people's vision of the threat from flooding may include being swept away or buildings being structurally impacted, there are actually a number of hazards associated with flooding that occur both during and after an event.

#### *During the Flood*

While a flood event is underway, citizens will be faced with a number of threats. The hydraulic power of water is significant and walking through as little as 6 inches of moving water is dangerous because of the possibility of losing stable footing. Driving through flood water is the cause of many flood deaths each year. As little as one foot of water can float many cars and two feet of rushing water can carry away most vehicles including SUVs. That fact, combined with an inability for drivers to judge the depth of flood water, as well as the potential for flood waters to rise quickly without warning, making driving through flood water a very unwise action.

In addition to being swept away, flood water itself is to be avoided. Because of leaking industrial containers, household chemicals, and gas stations, it is not healthy to even touch the flood water without protective equipment and clothing. Downed power lines, flooded electric breaker panels, and other sources of electricity are a significant threat during a flood. One should also be prepared for the outbreak of fire. Electric sparks

often cause fire to erupt and because of the inability of fire fighting personnel to respond, a fire can quickly burn out of control.

*After the Flood*

Cleaning up after a flood can also expose citizens to a number of threats. For example, electrical circuits or electrical equipment could pose a danger, particularly if the ground is wet. Buildings that have been exposed to floodwater may exhibit structural instability of walkways, stairs, floors, and possibly roofs. Flood waters often dislodge and carry hazardous material containers such as tanks, pipes, and drums. They may be leaking or simply very heavy and unstable. The combination of chemical contamination and the likely release of untreated sewage (necessary when the sewage treatment plant is overwhelmed with flood-swelled effluent) mean that drinking water supplies can be unusable. Fire continues to be a very real threat after a flood. First-responders could be occupied with more pressing emergencies and traditional fire suppression equipment may be inoperable, but there may be mobility problems that keep fire-fighting equipment to reach an outbreak. Finally, there is the mental toll of being involved in a disaster. Continued long hours of work, combined with emotional and physical exhaustion and losses from damaged homes and temporary job layoffs, can create a highly stressful situation for citizens. People exposed to these stressful conditions have an increased risk of injury and emotional crisis, and are more vulnerable to stress-induced illnesses and disease.

*Impact to Buildings*

Fortunately, the number of people killed or injured during floods each year is relatively small. The built environment within the floodplain, however, is likely to bear the brunt of a flood's impact. Whether the water is moving or standing, the exposure of buildings to flood water could cause a great deal of damage. If the water is moving, the differing hydraulic pressure inside the building vs. outside can cause the walls and foundation to buckle and fail. If the water is standing for any length of time, even materials above the flood height will become saturated with flood water as the flood water is absorbed (known as wicking). Certainly, most of the contents of flooded buildings that were located at or below the flood height will need to be discarded. This includes carpet, furniture, electronic equipment, and other household or commercial items. In most cases it is not simply the fact that the objects have become wet but since the flood water brings with it sediment and chemicals, it makes it nearly impossible to recover all but the most precious/heirloom items.

## Vulnerability Assessment

The goal of mitigation is to increase the flood resistance of a community, so that the residents and businesses will become less susceptible to future exposures to flooding, thereby resulting in fewer losses. A key component to reducing future losses is to first have a clear understanding of the current threats, the current probability that those threats would occur, and the potential for loss from those threats. The Vulnerability Assessment is a crucial first step in the process as it is an organized and coordinated process of assessing potential hazards, their risk of occurring, and the possible impact of an event.

### *Methodology*

The Vulnerability Assessment was conducted using HAZUS-MH MR3, FEMA's loss estimation software, to assess the County's built environment and critical facilities'

vulnerability to flooding. HAZUS-MH is a Geographic Information System (GIS)-based software tool that applies engineering and scientific risk calculations that have been developed by hazard and information technology experts to provide credible damage and loss estimates. These methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards, including floods, hurricane winds and earthquakes. The methodology supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards.

The primary input to any vulnerability assessment is a "depth of flood" grid. This flood depth grid was created using an elevation grid derived from LiDAR measurements with a 2 m spatial resolution. By incorporating the polygons of the 100-year floodplain from the FIRMs, the flood elevations from the Flood Insurance Studies for Calvert County, Chesapeake Beach, and North Beach, as well as the current elevation grid, HAZUS-MH was able to create a flood depth grid with a reasonable precision.

Once this flood depth grid was created, Calvert County's tax parcel centroids were digitally overlaid and those centroids that intersect the floodplain were selected. The height to the first finished floor of each building in the floodplain was determined by field inspection. The height to the first finished floor was then compared with the predicted flood depth to estimate the potential depth of water for each building. For each level of water depth, there is a corresponding "percent damaged" metric. The 2007 assessed value of the building was then adjusted based on a formula to account for the value of the contents of the building. The total value was multiplied by the percent damaged metric to calculate an estimate of damage from the 100-year flood event.

It is important to note when viewing the following results that the numbers generated carry with them a degree of uncertainty. The flood heights used to generate the flood depths are from an interpolated source (SLOSH output), as discussed above. Therefore, we recommend that these damage statistics be viewed as merely an indicator of the potential degree of damage and not as a final and absolute number.

***Results***

The results of the analysis indicate that there are 577 buildings within the 100-year floodplain in Calvert County (Table 2.4). When the flood depth grid (Figure 2.3) is intersected with the height of the foundations of each of these buildings, 10 of them show minimal damage. The maximum amount of damage predicted is 75% percent; 23 buildings in Calvert County could possibly sustain a severe degree of damage (50% or more). The total value of both the structures and their contents is over $178 million. The total potential damage from flooding is over $30 million. This number represents 17.1 percent of the total assessed value. When standardized per building, it is important to note that the most valuable buildings (average of $549,670) are those predicted to be damaged minimally (less than 10%). Unfortunately, those buildings expected to sustain moderate to significant damage (30% - 40%) are the least valuable buildings. The majority of the potential damage to flooding (63.3%) is likely to be to those 365 buildings damaged between 10 and 30 percent.

**Table 2.4 Potential damage to structures/contents from a 100-year flood event by degree of damage catego**

| Degree of Damage | Building Count | % of Total Count | Value of Structure and Contents | Value per Building | Total Potential Damage | Damage per Building | % of Total Damage |
|---|---|---|---|---|---|---|---|
| Less than 1% | 10 | 1.7% | $ 3,027,300 | $302,730 | $ 14,819 | $1,482 | 0.1% |
| 1 - 10% | 97 | 16.8% | $ 53,318,060 | $549,670 | $ 3,847,957 | $39,670 | 12.6% |
| 10 - 20% | 230 | 39.9% | $67,872,785 | $295,099 | $9,815,451 | $42,676 | 32.1% |
| 20 - 30% | 135 | 23.4% | $33,171,125 | $245,712 | $8,700,876 | $64,451 | 28.5% |
| 30 - 40% | 75 | 13.0% | $13,849,555 | $184,660 | $4,567,704 | $60,903 | 14.9% |
| 40 – 50% | 7 | 1.2% | $2,241,360 | $320,194 | $1,004,415 | $143,488 | 3.3% |
| 50% or more | 23 | 4.0% | $4,715,100 | $205,004 | $2,615,835 | $113,732 | 8.6% |
| Total | 577 | 100% | $178,195,285 | $308,830 | $30,567,059 | $52,976 | 100% |

Note: All dollar values are from 2007 tax assessments.

When the potential damage was also examined with respect to land use, it was found that the vast majority all of buildings in the 100-year floodplain in Calvert County were residential (Table 2.5). The second largest category was commercial buildings. While commercial buildings only account for 5.2% of the buildings impacted, its potential damage is nearly 3 times larger (14.3%). This suggests that mitigating commercial structures may offer an opportunity for mitigation, thereby reducing flood losses.

**Table 2.5 Potential damage to structures/contents from a 100-year flood event by general occupancy type**

| General Occupancy Type | Building Count | % of Total | Value of Structure and Contents | Total Damage | % of Total |
|---|---|---|---|---|---|
| Residential | 534 | 92.5 | 132,071,445 | 22,827,564 | 74.7 |
| Commercial | 30 | 5.2 | 17,127,780 | 4,382,715 | 14.3 |
| Educational | 1 | 0.2 | 713,500 | 261,431 | 0.9 |
| Government | 2 | 0.3 | 689,160 | 222,493 | 0.7 |
| Industry | 9 | 1.6 | 26,624,800 | 2,703,850 | 8.8 |
| Religious | 1 | 0.2 | 968,600 | 169,005 | 0.6 |
| Total | 577 | 100% | $178,195,285 | $30,567,059 | 100% |

Note: All dollar values are from 2007 tax assessments.

When the specific occupancies of each of the buildings in the 100-year floodplain were examined, a similar pattern emerged (Table 2.6). The majority of the structures damaged were single family residential (492 or 85.2% of the total). The occupancy types that were likely to suffer the greatest damage, besides single family dwellings, were entertainment & recreation businesses, food/drug/chemical industrial sites, multi-family dwellings, and temporary lodgings (i.e. hotels/motels).

**Table 2.6 Potential damage to structures/contents from a 100-year flood event by specific occupancy type**

| Specific Occupancy Type | Building Count | Value of Structure and Contents | Value per Building | Total Damage | Damage per Building |
|---|---|---|---|---|---|
| Retail Trade | 10 | $1,676,340 | $167,634 | $279,545 | $27,954 |
| Personal/Repair Service | 7 | $1,365,400 | $195,057 | $547,638 | $78,234 |
| Medical Office/Clinic | 1 | $757,000 | $757,000 | $352,553 | $352,553 |
| Entertainment & Recreation | 12 | $13,329,040 | $1,110,753 | $3,202,977 | $266,914 |
| Schools | 1 | $713,500 | $713,500 | $261,431 | $261,431 |
| General Government Services | 2 | $689,160 | $344,580 | $222,493 | $111,246 |
| Food/Drug/Chemical Industry | 9 | $26,624,800 | $2,958,311 | $2,703,850 | $300,427 |
| Church | 1 | $968,600 | $968,600 | $169,005 | $169,005 |
| Single Family Dwelling | 492 | $110,667,795 | $224,934 | $17,669,944 | $35,914 |
| Manufactured Home | 10 | $2,407,665 | $240,766 | $1,094,998 | $109,499 |
| Multi-Family Dwelling | 30 | $6,215,835 | $207,194 | $2,041,701 | $68,056 |
| Temporary Lodging | 2 | $2,780,150 | $6,390,075 | $2,020,919 | $1,010,459 |

Note: All dollar values are from 2007 tax assessments.

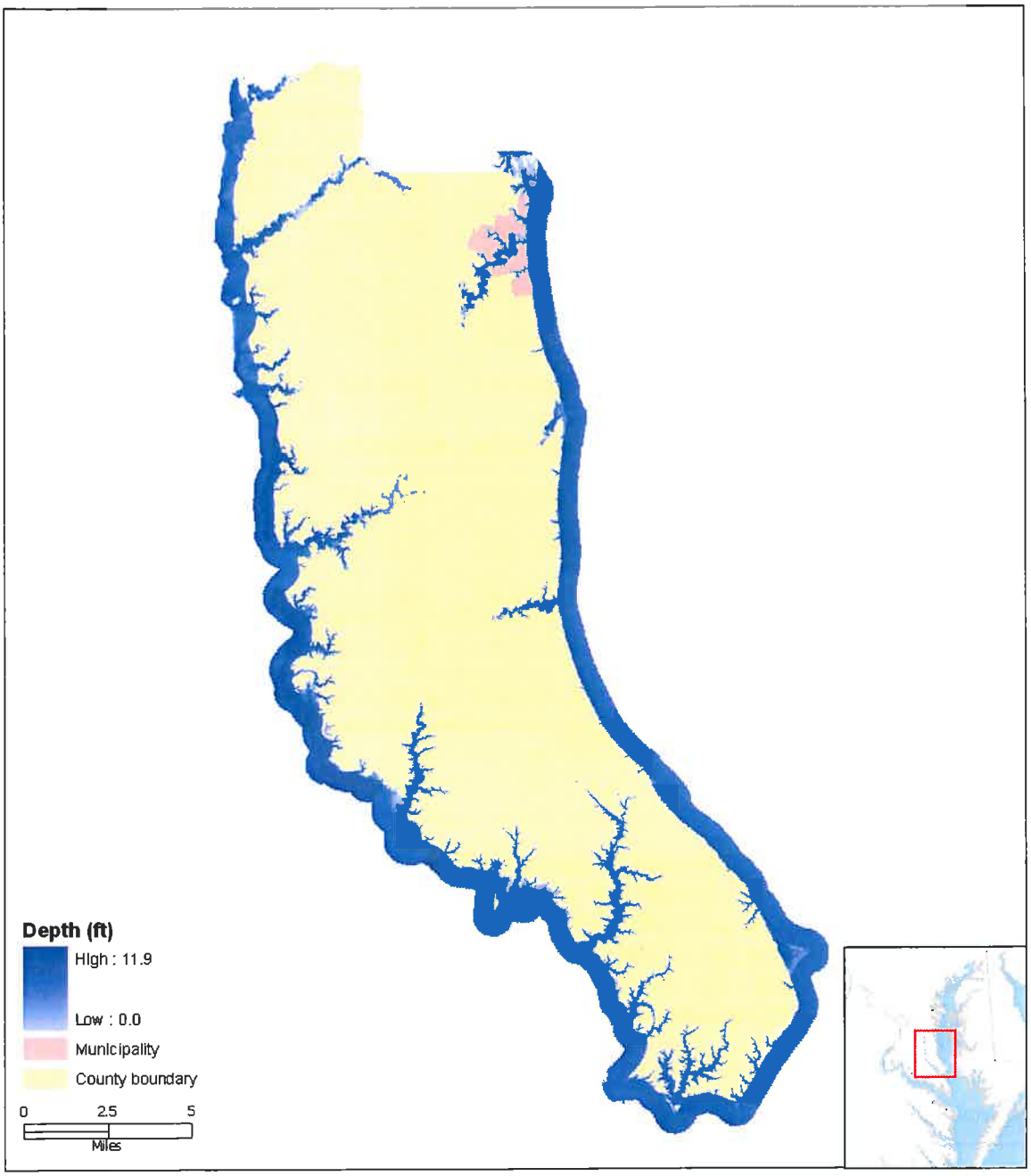
### *Critical Facilities*

In addition to the general building stock, critical facilities were also examined as part of the vulnerability assessment. Specifically, the location of wastewater treatment facilities, fire stations, police stations, and schools was compared to the flood depth grid. There were no critical facilities in the modeled flooded area. However, there were a few facilities very near (less than 100 meters) the flood zone. Given the uncertainty of model results and the potential for sea-level rise in Calvert County, the following facilities bear observance (Table 2.7).

**Table 2.7 Critical facilities within 100 meters of the modeled flood zone**

| Type | Name |
|---|---|
| WWTP | Industrial Park WWTP (Skipjack Road) |
| WWTP | Chesapeake Beach WWTP |
| Fire Station | North Beach Volunteer Fire Company |
| School | Our Lady Star of the Sea School |
| Police Station | Hallowing Point Station (MDDNR) |
| Police Station | Solomons Police Substation |

**Figure 2.3 Predicted 100-year flood depth**




***Spatial Distribution of Flooding***

The geography of the flood vulnerability can best be described as "dispersed." While there are certainly a few communities that find themselves entirely within the 100-year floodplain, most of the other vulnerable areas are either pockets of development along the Chesapeake Bay coastline or in the two municipalities in the north that were built specifically to take advantage of their proximate location on the water.

Areas of significant or moderate flood vulnerability in the county comprise the following areas, each of which is elaborated below.

- Cove Point (166 structures)
- Broomes Island (71 structures)
- Chesapeake Beach (70 structures)
- North Beach (61 structures)
- Plum Point (45 structures)
- Long Beach (32 structures)
- Breezy Point (23 structures)

**Figure 2.4 Flooding on Poplar Drive in Cove Point from the remnants of Tropical Storm Ida, November 2009**

*Cove Point (Figures 2.4 & 2.5)*

The Cove Point neighborhood will potentially be one of the most impacted during a coastal 100-year flood event. Nearly all (166) structures in the area may suffer flooding damage to their buildings and contents. Many are likely to be impacted significantly or severely. The Cove Point community was built on a sand split created by the longshore transport of sediment from north to south along the Calvert County shoreline. Behind the spit, a shallow bay has formed. The residents that are located along this back bay have reported flooding from rainfall runoff as well as astronomical tides. Combined with the precarious position of the community with regard to the Chesapeake Bay, many of the structures have low or no appreciable foundations, adding to their vulnerability. Finally, it is well known that periodic flooding events often cover the road leading to the community, cutting the residents off from access to emergency vehicles and medical care.

*Broomes Island (Figure 2.6)*

Broomes Island, a small waterfront community on the Patuxent River is the second-most vulnerable area in Calvert County to the 100-year flood. 71 structures are predicted to sustain some damage, some severe, from a 100-year event, which will most likely come in the form of the storm surge of a tropical storm. Areas that are particularly at risk in Broomes Island include Patuxent Avenue, Shady Lane, Songbird Lane, and Broomes Island Road near Oyster House Road. Again, the combination of physical proximity to the water and the lack of elevation of structures equal a significant degree of vulnerability.

**Figure 2.6 Potential flooding and building damage in Cove Point**

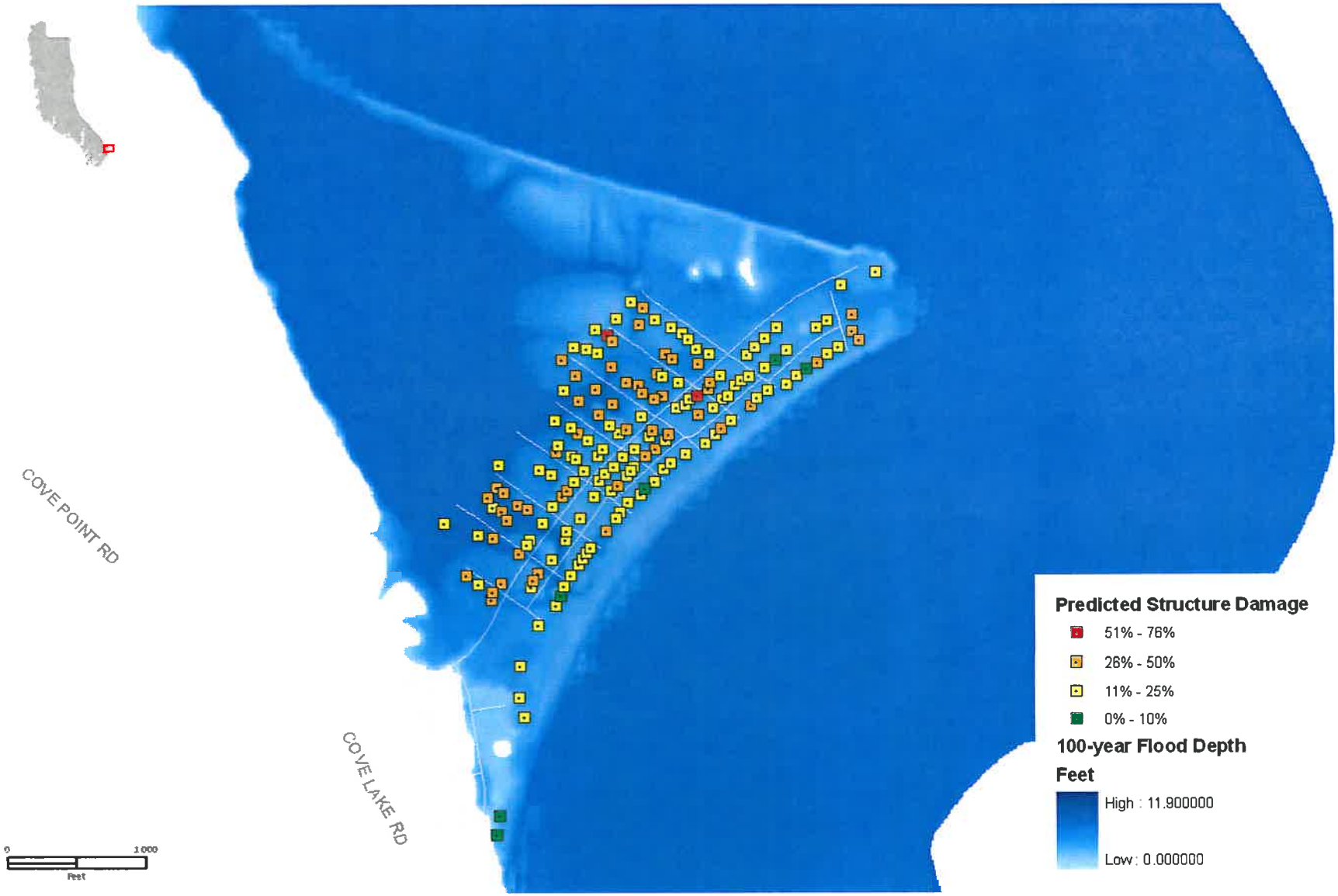
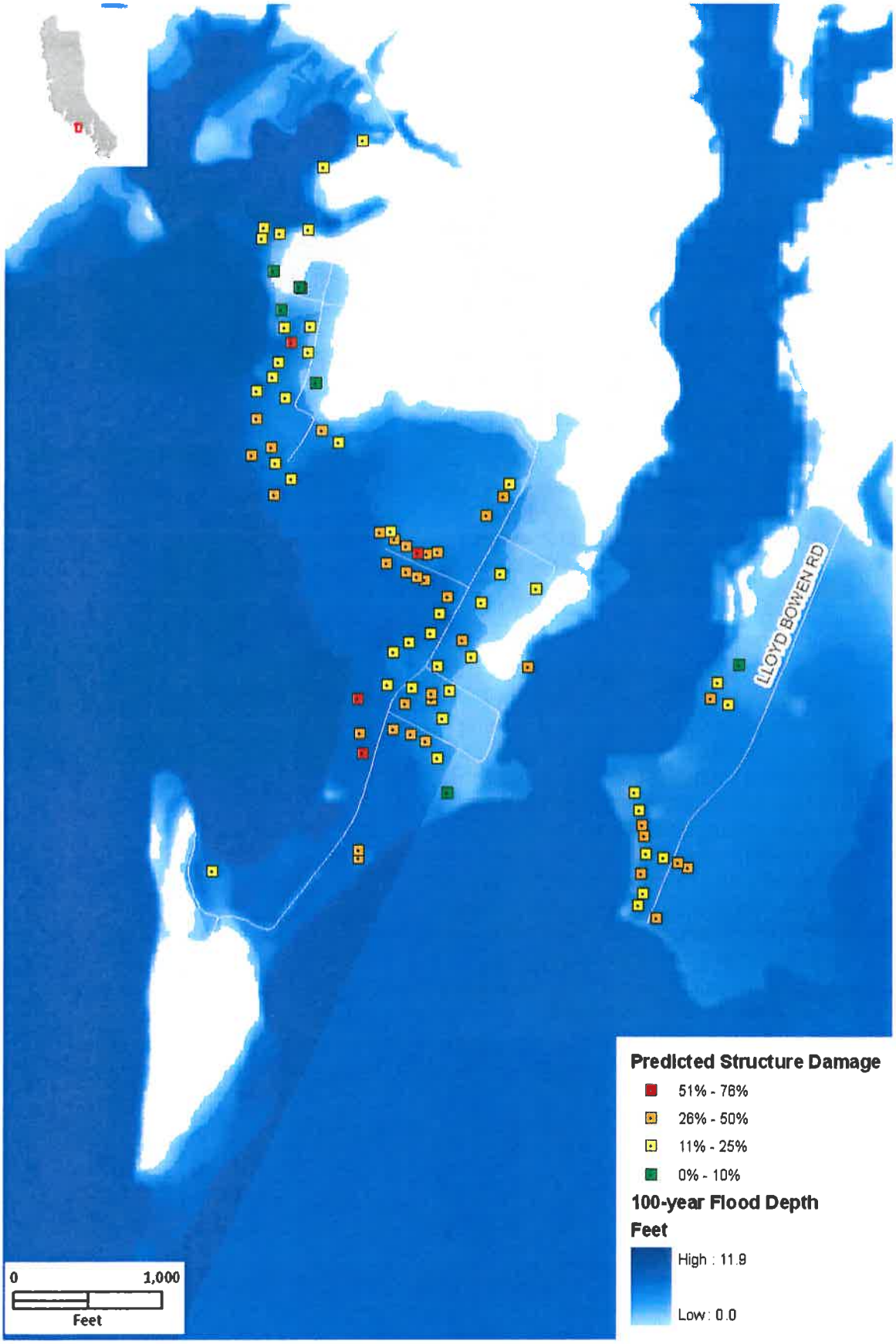


**Figure 2.7 Potential flooding and building damage in the Broomes Island**



*Town of Chesapeake Beach (Figures 2.7, 2.8 & 2.9)*

The Town of Chesapeake Beach is one of two incorporated municipalities in Calvert County. It was established as a beach resort around the turn of the last century. Given its proximity to the Chesapeake Bay and its relatively low topography (compared with the scarp landscape to the south), the area's flood vulnerability is well-known. Access to the tidal streams in the northern portion of the town is restricted by a seawall and a sluice gate (Figure 2.8). Approximately 70 structures are predicted to be impacted by the 100-year flood in the Town. However, many of these will be impacted minimally. The Town was affected by Hurricane Isabel greatly, with many vulnerable structures damaged and elevated when rebuilt. In fact, much of the more significant damage is predicted to be a result from storm surge flooding in Fishing Creek rather than the Chesapeake Bay frontage.

**Figure 2.7 Residential development along Fishing Creek Harbor in Chesapeake Beach**

**Figure 2.8 Sluice gate in Chesapeake Beach**

*Town of North Beach (Figures 2.10)*

The Town of North Beach is the other municipality in Calvert County. Owing its history to legalized gambling in Maryland, today it is a Chesapeake Bay resort town with both full-time and part-time residents, including commuters. The vulnerability of North Beach, caused by the low-lying topography and its proximity to the Bay, is mitigated somewhat by a seawall. Based on the computations by HAZUS-MH, it is predicted that 61 structures would be potentially impacted by the 100-year flood; a few would be severely damaged.

**Figure 2.11 Potential flooding and building damage in the Town of Chesapeake Beach**

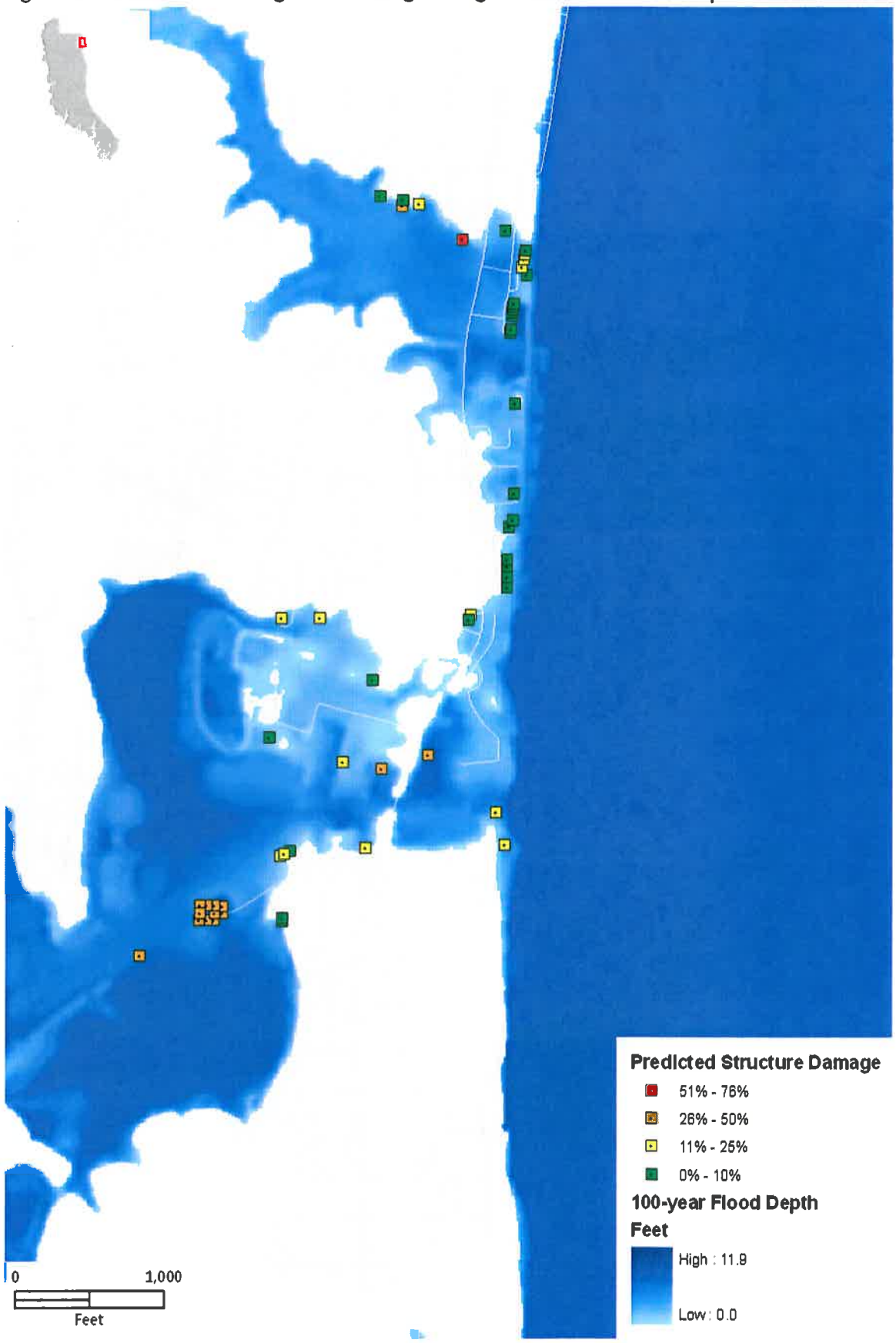
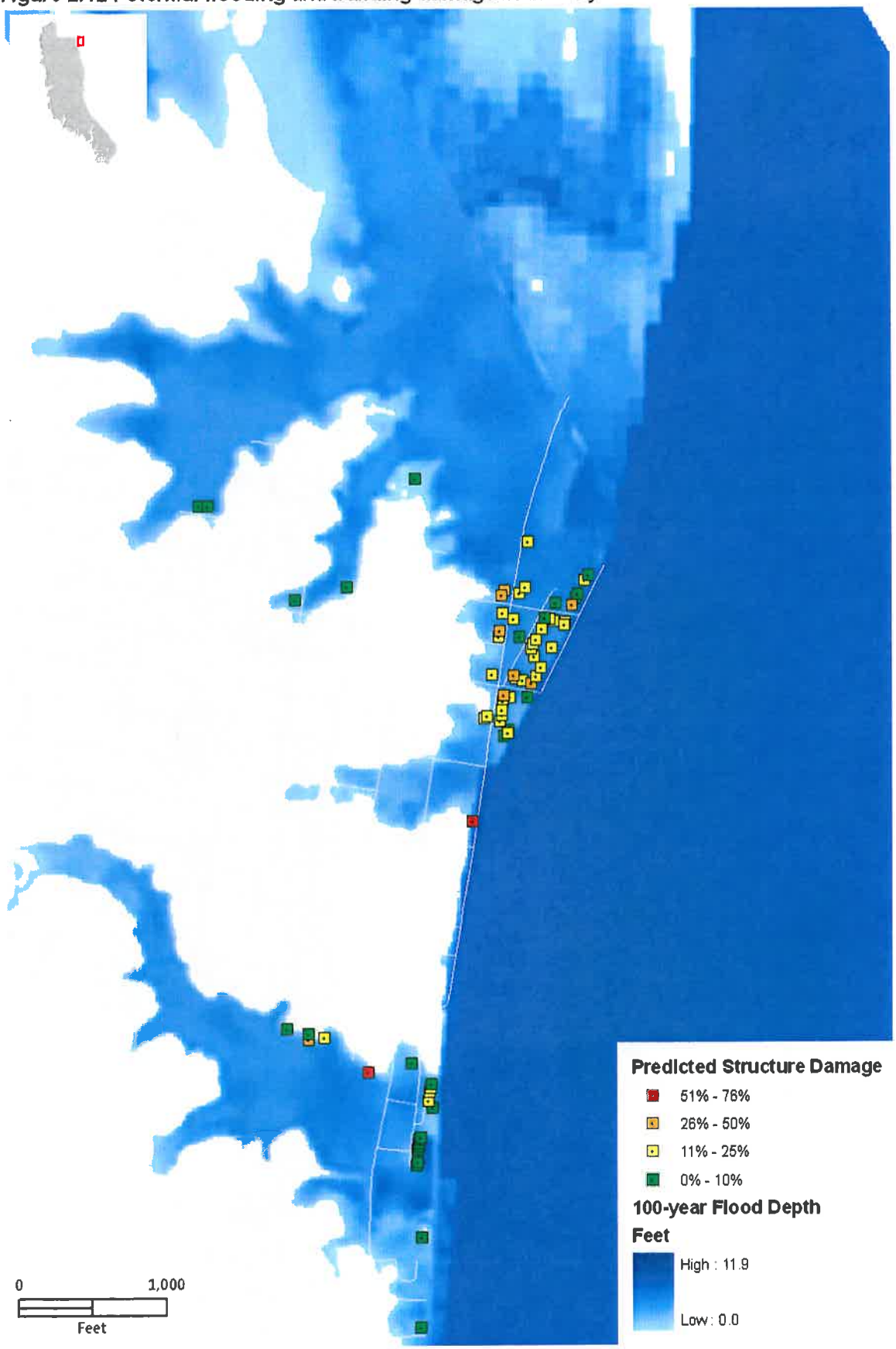


Figure 2.12 Potential flooding and building damage in the City of North Beach



*Neeld Estate / Breezy Point (Figures 2.11 & 2.12)*
Another area of the county that is consistently prone to flooding is the Plum Point/Breezy Point area. Located south of Chesapeake Beach on the Chesapeake Bay, the communities of Neeld Estate and Breezy Point sit on opposite sides of Plum Point Creek. The northern community of Breezy Point would likely have 23 structures damaged in a 100-year coastal flood event; Neeld Estate would likely have 45 damaged structures. In Breezy Point, the structures are concentrated along Breezy Point Road and Ridge Road and in Neeld Estate community, it is Beach Drive and Bay Boulevard that will likely be inundated the most.

**Figure 2.11 Sandbags protect a house in Neeld Estate from flooding caused by the remnants of Tropical Storm Ida in November 2009**

*Long Beach (Figures 2.13)*
The southern end of Long Beach (along Long Beach Drive, Bayberry Road, Beech Road, Walnut Road, Cedar Road, Cypress Road, and Oak Road) is vulnerable to flooding where up to 32 structures could be potentially damaged. This area that fronts the Chesapeake Bay is low-lying and many of the structures have either a crawlspace or no foundation at all.

Other areas with damaged buildings include Solomons (19 structures), Lloyd Bowen Road (17), Johnstown/Dowell (14), Dares Beach (8), Olivet (7), and Buzzard Island Creek (6). Finally, it bears mentioning that only 4 structures in the area of Owings were found that would be impacted by riverine flooding only. While riverine flooding does and will continue to occur, the HAZUS-MH model results suggest that the primary flood threat to Calvert County involves a coastal source.

## Repetitive Loss Properties

A repetitive loss property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A repetitive loss property may or may not be currently insured by the NFIP. Structures that flood frequently strain the National Flood Insurance Fund. Repetitive loss properties not only increase the NFIP's annual losses and the need for borrowing; but they drain funds needed to prepare for catastrophic events. Community leaders and residents are also concerned with the repetitive loss problem because residents' lives are disrupted and may be threatened by the continual flooding.

**Figure 2.13 Potential flooding and building damage in the Plum Point/Breezy Point area**

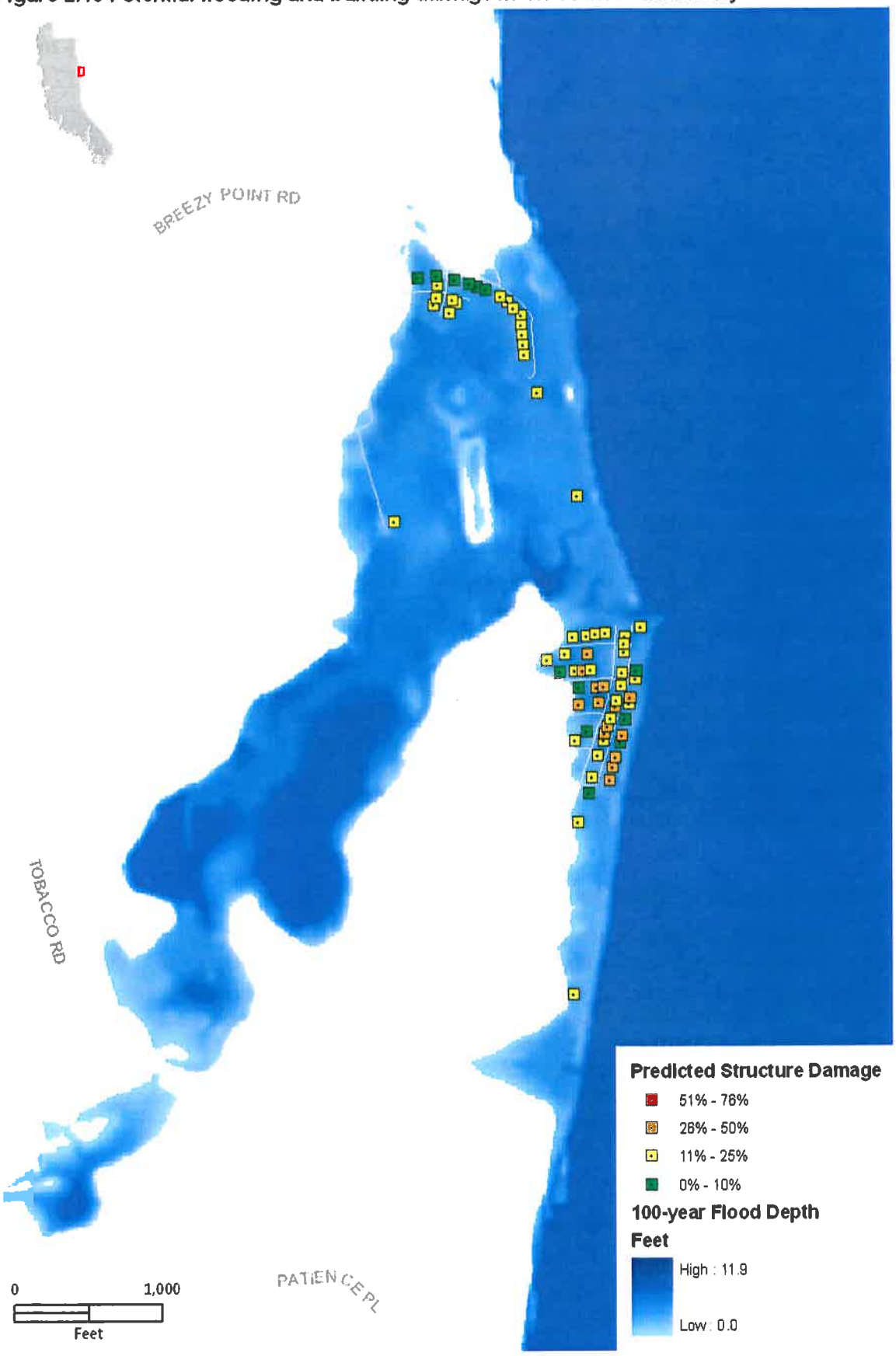
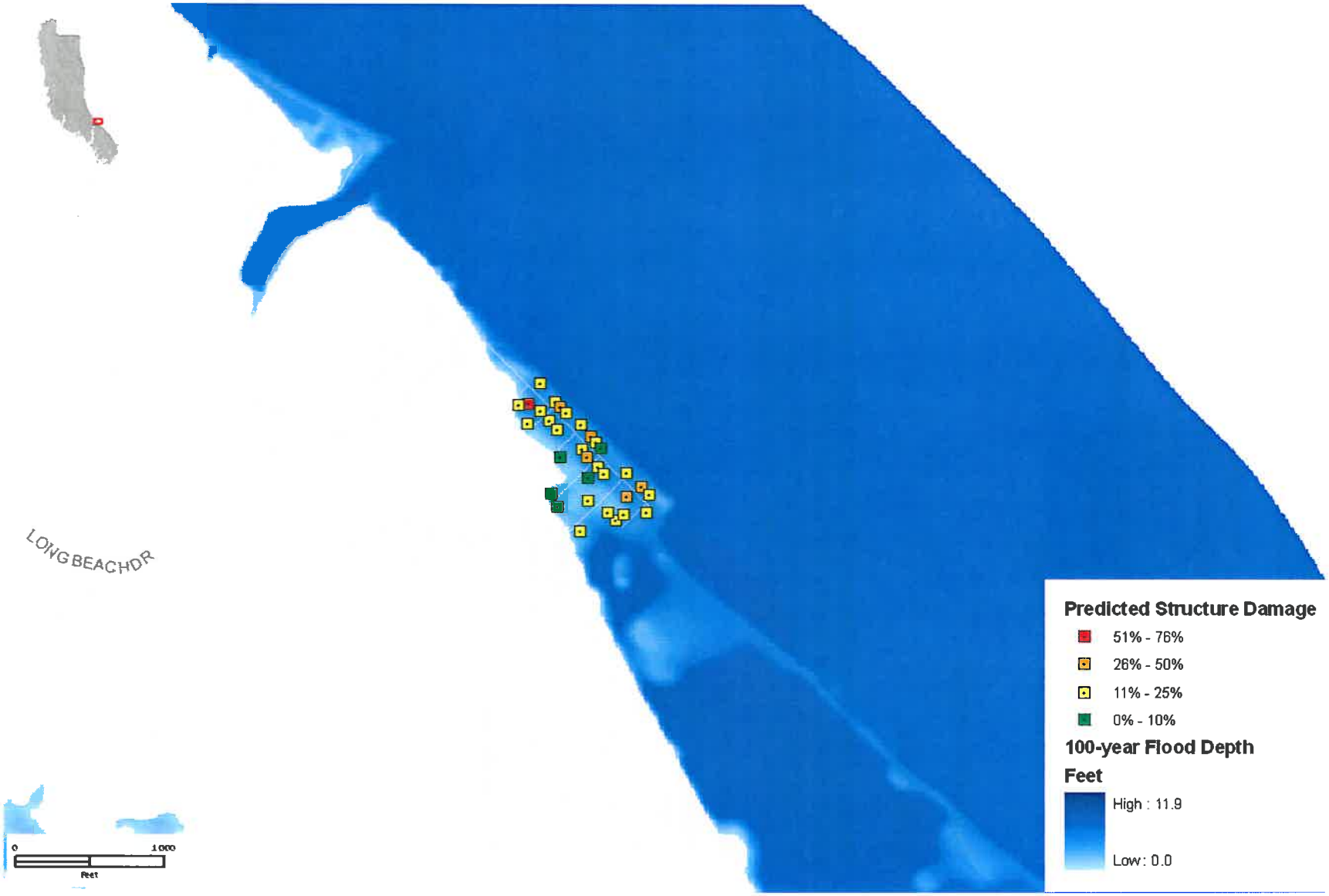


**Figure 2.15 Potential flooding and building damage in the Long Beach area**



According to the Maryland Department of the Environment as of March 2009, Calvert County has 39 unmitigated repetitive loss properties. According to their property address, the following areas contain these repetitive loss properties:

- Lusby (Cove Point)– 15 properties
- Saint Leonard (Long Beach) – 6 properties
- Huntingtown (Plum Point) – 5 properties
- Town of North Beach – 5 properties
- Town of Chesapeake Beach – 3 properties
- Broomes Island – 2 properties
- Owings – 2 property
- Solomons – 1 property

## Economic Impact

### *Businesses*

Floods cause other problems that are not as easy to identify as damage to buildings and critical facilities. Businesses that are disrupted by floods often have to be closed, often for long stretches of time. Inventories are lost, businesses cannot be accessed by customers, and employees are often busy protecting or cleaning up their flooded homes.

### *Impact on taxes*

Public expenditures on flood fighting, sandbags, fire department calls, clean up and repairs to damaged public property affect all residents of Calvert County. While a state or federal disaster declaration may help reimburse the County, these handouts cannot be counted on in the future. Further, a recent law now requires that public agencies purchase insurance. The amount of insurance that should be carried will be deducted from disaster assistance payments. Despite Federal and state disaster assistance, public agencies incur many expenses that must be paid by local taxpayers.

### *Transportation*

Loss of road access is a major flood impact that could affect the residents and businesses, not just those that own property in the floodplain. This can have an impact on not only the direct costs to fix the roads/bridges but also the value of lost time and productivity for the County's residents. As with taxes, these costs are borne by everyone, not just floodplain residents.

### *Other impacts*

Finally, areas that are consistently prone to flooding will have a negative impact on property values, thereby encouraging neighborhood destabilization factors such as blight and crime to take over.

## Future Trends

Between 1970 and 2000, Calvert County's growth rate was 8.7%/yr (from 20,682 to 74,563 persons). Based on County growth management policies and economic trends, the average annual growth rate slowed to 1.9% between 2000 and 2010 (from 74,563 to

88,737 persons) and only increased 0.7% between 2009 and 2010. This slower growth trend creates an opportunity with regard to flood vulnerability in the county. With a slower pace, it will be easier to continually monitor the collective vulnerability of Calvert County's residents and businesses and suggest changes to policies as the years progress.

On the other hand, while a slowing rate of growth will have a moderating effect on the flood vulnerability of the County, aggravating this vulnerable situation is the potential for sea-level rise combined with subsidence. The flood depth model created in this vulnerability mapping effort suggests that because of the topographic characteristics, sea-level rise is not likely to impact a large amount of land area in the county not already vulnerable to flooding, except in the most severe scenarios. What even a small amount of sea-level rise is likely to increase, however, is the frequency of flood stage levels of water, the degree of damage from relatively frequent flood levels, and the damage of fresh water supplies as salt water intrudes into surface streams and groundwater supplies. Citizens and leaders should be informed about these facts so they may take appropriate actions for coastal and riverine flooding.

## Conclusions

Several conclusions can be made regarding the question of flooding vulnerability in Calvert County. First, given that Calvert County is surrounded on three sides by water and given that it contains more than 31,000 improved properties, the fact that only 577 (1.8%) are vulnerable to flooding is probably a result of strong land use regulations and the leadership and foresight to implement them (as well as a fortuitous geomorphology). Second, given the potential for sea level rise and subsidence in the coming decades, the time to increase the County's efforts to protect its citizens from flooding is now. Third, even though making the County largely flood-resistant, there are certain areas that remain very vulnerable, such as Cove Point and Broomes Island, for which there is no easy answer. In the chapters that follow, a number of potential actions will be recommended. In the end, it will be incumbent upon the people of Calvert County to reduce their personal vulnerability to flooding.

# CHAPTER 3: PREVENTIVE MEASURES

## Introduction

Preventive measures include codes and regulations found in plans and ordinances (comprehensive plans, zoning ordinances, building codes, floodplain development regulations, stormwater management regulations, and open space preservation) that are put in place to keep issues such as flooding problems from occurring or exacerbating. They are usually administered by the jurisdiction's planning, public works, and/or code enforcement departments. Preventive measures are also introduced to ensure that future development does not increase the potential damage caused by a flood or other hazard and that new construction does not contribute to the flood risk, thereby reducing the community's vulnerability.

Comprehensive plans, master plans, and zoning ordinances typically contain language to keep damage-prone development out of the hazardous or sensitive areas, while building codes and floodplain development regulations impose construction standards on what is allowed to be built in the floodplain. They protect buildings, roads, and other projects from flood damage and prevent development from aggravating the flood problem. Stormwater management regulations address the runoff of stormwater from new developments onto other properties.

The sections below include a review of Calvert County and its municipalities' codes, plans, and ordinances and identify areas in these documents where hazard mitigation principles are addressed. Recommendations for future actions are intended to provide Calvert County with ideas to better integrate hazard mitigation into other plans and activities.

## County/Municipality Plans and Ordinances

### *Calvert County Hazard Mitigation Plan –2004*

Of the 14 hazards that were assessed, flooding and hurricanes/tropical storms were among the top five high-risk hazards. The Plan identifies the following goals and objectives that pertain to flooding and that will be revisited during the preparation of this Flood Mitigation Plan:

- Goal: Prevent flood-related repetitive losses from natural disaster through regulation and education
    - Develop and support public and private projects and programs to retrofit, relocate, or acquire structures susceptible to repetitive flooding.
    - Require systematic maintenance programs for stormwater management systems.
    - Direct population concentrations away from known or predicted high hazard areas through appropriate regulations.
- Goal: Emphasize pre- and post-disaster planning to decrease vulnerability of existing and new construction to loss.

- Identify vulnerable existing public and private critical facilities and encourage pre-disaster retrofit.
- Promote accuracy of FIRMS by requesting FEMA restudy of the floodplain.

The Plan identified the following actions that should, again, be taken into consideration during the preparation of the flood mitigation plan.

High Priority Mitigation Actions

- Encourage uninsured property owners in known flood hazard areas to purchase flood insurance through the NFIP.
- Ensure municipal compliance with local Stormwater Management Plans.
- Store the community's FIRMs and FIS in an easily accessible location and make them available for public inspection. Conduct routine inspections, regular maintenance and annual tests on all emergency communications equipment, public awareness systems, and hazard alert sirens to ensure unhindered operation during an emergency event.

Medium Priority Mitigations

- Coordinate with the local municipalities or the DOT on the potential feasibility of replacing, removing, or enlarging bridge and culvert stream crossings that are unable to pass the 10-year frequency flood flow.
- Ensure continued contractor compliance with approved Erosion and Sediment Control Plans and continue to work with local farmers to implement best management practices.
- Preserve the highest priority for undeveloped floodplain areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical floodplain areas may be preserved/protected via local ordinances.
- Elevate known flood-prone structures in accordance with the general guidelines.
- Relocate and/or acquire known flood-prone structures with the general guidelines.

***Calvert County Comprehensive Plan - 2010***

The following objectives in the Natural Resources and Sensitive Areas section in the Plan have a direct impact on flood mitigation principles:

- Establish a comprehensive approach to environmental planning with special emphasis on watershed planning.
- Protect environmentally sensitive areas such as floodplains, wetland and water way buffers from development impacts.
- Preserve stream valleys to maintain the natural functions and to provide greenways throughout the County.

The Plan identifies the following specific actions to address sensitive areas, streams and buffers, wetlands, and floodplains that should continue to be implemented:

- Establish greenways systems along stream valleys to preserve the low lands.
- Require and maintain sufficient buffers from all perennial and intermittent streams to provide environmental protections.
- Reforest stream buffers wherever possible.

- Consider altering the 50 foot buffer requirements.
- Continue to direct development out of the floodplain.
- For development in the floodplain, ensure that construction practices minimize damage to property and the environment during flooding.
- Require vegetation in floodplain to remain except when it is required to be removed for stormwater management.

The Plan recommends improving the environmental education programs through the Board of Education and developing environmental education programs for adults.

As summarized in the 2004 Hazard Mitigation Plan, the County has instituted a number of techniques to protect wetlands, floodplains, and steep slopes. Since 1988, a 100-foot Critical Area buffer has been established for the county's waterways and the allowable density in the 1,000-foot (from Tidal waterways) Critical Area was reduced to 20 acres per dwelling unit.

The Plan also identifies incentives given to use low-impact techniques such as rain gardens and bioretention that greatly reduce run off by keeping water onsite.

***Calvert County Zoning Ordinance – Revised October 2010***

The zoning ordinance addresses wetlands, buffers, and natural resources protection.

Article 7 of the Zoning Ordinance comprises the Subdivision Regulations.

- Land may be found unsuitable for subdivision or development due to features which will reasonably be harmful to the safety, health and general welfare of the subdivision such as Natural Resources Protection Areas.
- Development of designated Floodplain Districts are restricted to specific uses and require to be in accordance with erosion and sediment control plans approved by the Calvert Soil Conservation District. A minimum 10-foot setback is required to be established adjacent to 100-year floodplain areas.
- Minimum sufficient contiguous suitable land area, exclusive of steep slopes (greater than 25 percent), buffers, forest retention areas, septic recovery areas, and required setbacks, are required to have at least 5,000 square feet for lots having individual septic systems and 3,000 square feet for lots served by a public or community septic system.

Article 8 of the Zoning Ordinance addresses Environmental Regulations

- The Critical Area buffer (100 feet) minimizes the adverse effects of human activities on wetlands, shorelines, stream banks, tidal waters, and aquatic resources. The Buffer can be expanded beyond 100 feet to include contiguous, sensitive areas, such as steep slopes, hydric soils, or highly erodible soils, whose development or disturbance may impact streams, wetlands, or other aquatic environments.
- New subdivisions are required to be designed to locate all house sites out of the 100-year floodplain area.

- A wetland buffer zone of 50 feet is required to be maintained adjacent to non-tidal wetlands and 100 feet adjacent to tidal wetlands is required to be maintained. A 10-foot setback is required to be maintained from the edge of the wetland buffer.

Article 8-3 of the Zoning Ordinance addresses Forest Conservation Requirements

- A Forest Stand Delineation and a Forest Conservation Plan is required for any subdivision development in addition to a grading permit and sediment and erosion control permit.
- Retention, afforestation and reforestation areas on the lots are required to be identified on the final subdivision plat as forested areas that will be left undisturbed in perpetuity and to serve water quality benefits.
- Standard Forest Stand Delineations are required to show the location of the 100-year floodplains and not-tidal wetlands and their buffers.
- The establishment or enhancement of forest buffers adjacent to intermittent and perennial streams to widths of at least 50 feet and the establishment or enhancement of non-forested areas on 100-year floodplain are considered a priority for afforestation and reforestation.

***Building Codes***

Building codes set construction standards for the minimum acceptable level of safety for buildings in a community and are also important in mitigating the impact of non-flood hazards on new buildings. Hazard protection standards for all new and improved or repaired buildings can be incorporated into the local building code. Typically, these standards should include criteria to ensure that the foundation will withstand flood forces and that all portions of the building subject to damage are above or otherwise protected from flooding.

The International Building Code (IBC) serves as the County's basic building code. The IBC regulates construction materials and methods for all structures (except for one and two family dwellings). The one and two-family dwellings are regulated by the International Residential Code (IRC). The IBC and IRC establish criteria that resist damage to natural hazards including wind speed (for hurricane, tornados, thunderstorms, winter storms) seismic activity, snow load, and flooding. This code prohibits building in any 100-year floodplain or stream or drainage course and prohibits development in any area that is subject to flooding, erosion, unstabilized slope or fills within the danger reach of a high-hazard dam. However, these codes are not retroactive codes, and do not include older buildings. Only pre-existing structures are subject to the codes that exist at the time of construction and when there are major additions to structures, they need to be brought up to the new code's standards. Older buildings are more vulnerable to damage from natural hazards unless they are brought up to the current code's standards.

<u>Building Code Effectiveness Grading Schedule</u>

The Building Code Effectiveness Grading Schedule (BCEGS) is a program that measures local building code natural hazard protection standards and code administration. The Building Code Effectiveness Grading Schedule is used by the insurance industry to determine how well new construction is protected from wind, earthquake, and other non-flood hazards. The BCEGS program assigns each municipality a BCEGS grade from 1 (exemplary commitment to building-code

enforcement) to 10. The County has not been evaluated for a BCEGS score nor does it anticipate going through this process in the near future.

***Calvert County Floodplain Development Ordinance – Revised March 1992***

- Any development within the floodplain zone is required to obtain a permit from the local permitting agency.
- The freeboard requirement is one foot above the base flood elevation.
- Wetland disturbance is required to be avoided. State and federal permits are required for any development that encroaches into wetlands.
- Basements are not permitted. All new or substantially improved residential and non-residential structures are required to have the lowest floor elevated to or above the flood protection elevation.
- Consideration should be given to clustering development lots out of the floodplain and preserving the open space.
- All new or substantially improved structures are required to be elevated on adequately anchored pilings or columns to resist movement due to the effect of the 100-year water loads and wind loads acting at the same time on all the building components.
- Utilities – distribution panel boxes are required to be at least two feet above the flood protection elevation and all outlets and electrical installations (heat pumps, air conditioners, generators, etc.) are required to be installed at or above the flood protection elevation.

The Ordinance also includes a requirement for new structures in the floodplain to submit first floor elevations.

***Town of North Beach Floodplain Management Ordinance – Revised March 1991***

- 100-year elevations are required to be determined and certified by a Registered Professional Engineer for all development proposals involving five acres or more or the creation of five lots or more.
- The freeboard requirement is one foot above the base flood elevation.
- Electric and mechanical systems are required to be elevated to one foot above the base flood elevation.
- Electrical distribution panels are required to be elevated three feet above the base flood elevation.
- Fill is permitted so long as it does not adversely affect neighboring properties.
- Manufactured homes (new, replaced, or substantially improved) are required to be elevated so that their lowest floor will be at or above one foot above the base flood elevation.
- Manufactured homes are required to be securely anchored to their foundations.
- In the Coastal High Hazard Area, all development proposals are required to meet the minimum standards established by FEMA's Coastal Construction Manual.

***Town of North Beach Zoning Ordinance – Revised January 2005***

- The ordinance contains a floodplain overlay district that comprises all the tidal flood plain and coastal high hazard areas as delineated by the FIRMs. All provisions of the Town's floodplain ordinance apply in this district. All uses permitted in the underlying district are permitted in the Overlay District.
- A Critical Area overlay district includes those areas within 1,000 feet of all tidal waters and tidal wetlands in the Critical Area of the Town. The district provides special regulatory protection for the natural resources located within the Town

Critical Area by requiring more sensitive development activity in these areas. Land within the Critical Area overlay district is divided into three land use designations: Intensely Developed Areas (IDAs); Limited Development Areas (LDAs); and Resource Conservation Areas (RCAs), each of which, have specific development standards.

- A Growth Allocation District (is not mapped) but is designated for use within the Critical Area Overlay District on lands classified as Limited Development Areas. Only specific development projects that have been approved by the Mayor and Council are approved for the Growth Allocation District classification and thereby receive Critical Area Growth Allocation.

***Erosion and Sediment Control Ordinance – 1993***

- Any land development in the floodplain is required to have a sediment control and stormwater management control permit.
- A grading permit and implementation of soil erosion and sediment controls is required for any development that results in disturbance greater than 5,000 square feet of land area and more than 100 cubic yards of earth, cut or fill.
- Erosion and sediment control is required during construction projects in order to reduce siltation and loss of channel carrying capacity.
- Dumping or placing debris in stream channels is prohibited.

***Calvert County Storm water Management Ordinance – July 2001***

- Any development that disturbs over 5,000 square feet of land area, including new and redevelopment is required to provide stormwater management.
- All redevelopment projects are required to reduce existing site impervious areas by at least 20 percent.
- The County and its municipalities are required to design Best Management Practices to control the 10-year frequency storm where historical flooding problems exist.

***Watershed Management Plans***

- Currently, draft watershed management plans exist for Parkers Creek and Hunting Creek. There are plans to develop watershed management plans for all of the county's major 12-digit tributaries.

***Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS)***

The Flood Insurance Study and Flood Insurance Rate Maps for North Beach and Chesapeake Beach were completed in 1984 and Calvert County's FIRM was completed in 1998. DFIRMS are in the preliminary stages. There has been no restudy done for the County; only a model rerun. The DFIRMS will be a digital conversion of the old paper map into a digital layer. Floodplain information is administered and disseminated by the County's Planning and Zoning Department.

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***National Flood Insurance Program***

The National Flood Insurance Program (NFIP) is a Federal program that enables property owners in participating communities to purchase flood insurance as protection against flood losses, while requiring state and local governments to enforce floodplain management regulations that reduce future flood damages. The NFIP plays a critical role in encouraging communities to adopt and enforce floodplain management regulations and to implement broader floodplain management programs. The county and

the municipalities of North Beach and Chesapeake Beach participate in the NFIP but are not members of the Community Rating System (CRS). The County was enrolled in the CRS program from 1989 to 1998. Due to staff changes, their participation in the program was discontinued.

***Continued Compliance with NFIP***

The Maryland Department of the Environment (MDE) works closely with FEMA to provide assistance to communities participating in the NFIP. The County participates in the NFIP and has its own floodplain ordinance that requires all new or substantially improved residential and non-residential structures to have the lowest floor elevated to or above the flood protection elevation.

***Maryland State Model Floodplain Ordinance***

A Maryland State Model Floodplain Management Ordinance that contains recommendations for improved management of floodplains has been adopted by communities participating in the NFIP including those in Calvert County. The Building Officials Code Administrators National Building Code includes flood provisions that, in part, satisfy the minimum requirements of the National Flood Insurance Program. A comparison of the code provisions and the City's Floodplain Ordinance could identify inconsistencies between the documents and ensure they are not in conflict with each other.

Some highlights from the Maryland State Model Floodplain Ordinance are included below:

- All new and substantially improved structures are required to be built one-foot above the base flood elevation.
- Ordinances do not allow buildings or fill in the floodway. Any development that impedes floodwaters or causes an increase in water surface elevations during the 100-year flood is not allowed.
- Existing buildings can only be replaced or substantially improved so long as they don't increase in footprint and any minor additions are required to be elevated.

***Capital Improvements Program***

The Capital Improvements Program is administered by the County's Public Works Department and identifies funding for projects in a variety of categories. Between FY2011 and FY2015, expenditures have been budgeted for: Dares Beach waterline/tank painting, east Prince Frederick water tower and well, Lakewood water system upgrade, Chesapeake Heights/Dares Beach water treatment, and water meter replacement project.

## State Plans

Planning studies include a wide variety of projects such as comprehensive plans, master plans, land use plans, revitalization plans, mitigation plans, and transportation plans. In general, land use plans and comprehensive plans discuss the direction of growth of the community and can pave the way to integrate principles of hazard mitigation.

***Maryland Hazard Analysis - 2005***
The State Hazard Analysis provided Calvert County a medium-high risk ranking for tidal/coastal flooding, a medium-low ranking for flash flooding, and a low risk ranking for riverine flooding. The most vulnerable areas identified in the Analysis include the areas near Battle, Hunting, and Hall Creeks. The Analysis identifies most areas bordering the Chesapeake Bay are protected from flooding by the bluffs that characterize this portion of the Bay's western shore with the exception of low-lying areas near Cove Point, Long Beach, Parker's Creek, and upper North Beach.

***State of Maryland Hazard Mitigation Plan – September 2004***
The State Hazard Mitigation Plan identifies a number of objectives and policies to assist local communities such as Calvert County and its municipalities with their hazard mitigation strategies. The following specific mitigation actions discuss the State's support to local governments with local mitigation projects:

- Since many important mitigation decisions are and will continue to be made at the local government level MEMA will continue to support the development and implementation of local hazard mitigation plans.
- MEMA will integrate local mitigation plan mitigation goals, objectives and strategies into the 2007 State of Maryland Hazard Mitigation Plan and future updates.
- MEMA will continue to support local governments in the updating and development of local hazard mitigation plans by providing extensive technical assistance. This assistance will include continued training on regulatory requirements and the use of Hazard Analysis and Risk Assessment Data.
- MEMA will partner with responsible State agencies to identify mitigation strategies for State-owned facilities that have been identified in the Risk Assessment as located in hazard areas for flash and riverine flooding.
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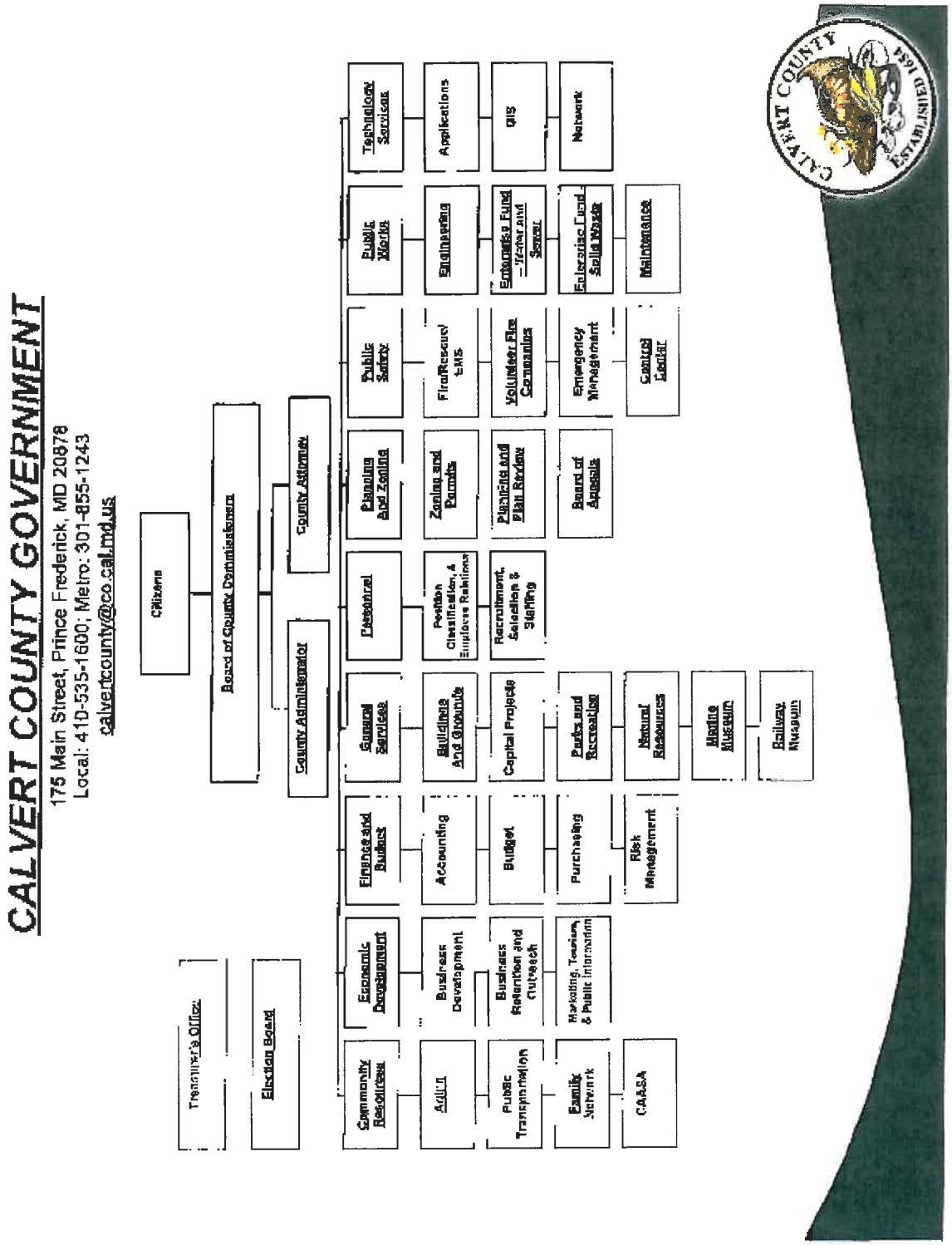
## County Government, Departments, and Staffing Capabilities

Calvert County was established 1654 and renamed Patuxent County by the Puritans and then renamed Calvert County. It is governed by a Board of County Commissioners. Calvert County government comprises the following departments: Community Resources, Economic Development, Finance and Budget, General Services, Personnel, Planning and Zoning, Public Safety, Public Works and Technology Services (see Organizational Chart, Figure 3.1).

Staffing for flood plain management and flood mitigation related projects:

- Department of Economic Development: Calvert County's Department of Economic Development focuses on encouraging existing businesses, attracting new employers, and promoting tourism. The Department also handles public outreach through a Public Information Specialist.

Figure 3.1 County Organizational Chart



- Department of Public Safety: The Department of Public Safety manages daily emergency response calls; works to mitigate manmade, technological and/or natural disasters; and serves as a point of contact and coordination for Homeland Security issues at the County, State, and Federal levels. Public Safety functions as a reference or resource center for all emergency related issues.
- Emergency Management Division (EMD): The Emergency Management Division, Department of Public Safety, strives to minimize the effects of future disasters through mitigation, planning, training and response efforts. The Division maintains and updates the Emergency Operations Plan and promotes public awareness of disaster prevention or preparedness to insure the County is ready for any emergency. The Division staff includes the Division Chief, Emergency Planner, Emergency Management Specialist and office assistant.
- Fire, Rescue & Emergency Medical Services Division: This division within the Department of Public Safety is responsible for providing fire protection, rescue and emergency medical services to the citizens of Calvert County. The Division staff includes the Coordinator, Assistant Coordinator, Recruitment and Retention Specialist and the volunteer fire and rescue companies.
- Department of Planning & Zoning (P&Z): P&Z is responsible for county-wide zoning, plan and map updates. This Department in conjunction with EMD administers the NFIP for Calvert County. P&Z also administers and supervises the Critical Area and Forest Conservation Programs, permit review, Site Plan and Subdivision review, Board of Appeals, Planning Commission, and zoning violations (including floodplain violations). Relative to floodplain management, P&Z has one code enforcement officer and two code enforcement inspectors, a reviewer who is a Certified Floodplain Manager for all floodplain permits, the Floodplain Administrator (Zoning Officer), a GIS/mapping specialist, a site plan/subdivision reviewer who also insures compliance with the floodplain regulations, a Principal Environmental Planner that processes amendments to the Floodplain Ordinance and supervises environmental review staff and a Board of Appeals Planner.
- Department of Public Works (PW): The primary functions of PW include: engineering and stormwater management project review, developing the County transportation system (roads), sediment and erosion control inspection, developing and managing the public water and sewer and solid waste facilities and fleet and highway maintenance (including bridge construction and maintenance.
- Department of Technical Services (TS): There are two GIS Specialists in this department.

# CHAPTER 4: PROPERTY PROTECTION

## Introduction

Property protection measures comprise those techniques used to modify existing buildings that are subject to flood damage. Most of these measures are implemented by or cost-shared with property owners and are thus relatively inexpensive to the community compared with other structural flood protection measures. The benefit of many of these protection measures is that they do not usually affect the appearance or use of a building. Examples of property protection measures include: relocation, acquisition, building elevation, flood-proofing, sewer backup protection, flood insurance, and mandates.

## Building Relocation

Relocation involves moving a building to another location on higher ground. While this is often the best way to protect it from flooding, it can prove expensive for heavier (exterior brick and stone wall structures and for large and irregularly shaped buildings). Relocation is also preferred for large lots that include buildable areas outside the floodplain or where the owner has a new flood-free lot (or portion of their existing lot) available. All building relocation projects are administered by the County's Emergency Management Division.

## Acquisition

Acquisition is similar to relocation, where buildings in the flood-prone area are removed to avoid future damage to them. However, in this case, the buildings are acquired by the local or state government and the land is converted to public use such as a park. No cost is borne by the homeowner. Acquiring buildings and removing them from the floodplain is not only the most effective flood protection measure available, it is also a method to convert a problem area into a community asset and obtain environmental benefits. However, a "checkerboard" pattern in which nonadjacent properties are acquired could occur when some owners are reluctant to leave.

Acquisitions can be funded by the Federal Emergency Management Agency (FEMA) using post-disaster mitigation funds that are administered through the Maryland Emergency Management Agency (MEMA). The buyout would involve eligible willing sellers only and be funded with 75 percent federal dollars and 25 percent local match. Three properties have been acquired in the County. The acquired properties are located at Cove Point, Kenwood Beach, and Hallowing Point Trailer Park at the Route 231 Bridge.

## Building Elevation

This technique involves raising a building above the flood level so that water can flow under the building, causing little or no damage to the structure or its contents. Elevating a building will change its appearance. If only a small elevation is required, such as a

couple feet, the front door would be three steps higher than before. If the building is raised eight or more feet, the lower area can be wet flood-proofed and used for parking and for storage of items that will not be damaged by flood waters.

Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. Elevation has proven to be an acceptable and reasonable means of complying with NFIP regulations that require new, substantially improved, and substantially damaged buildings to be elevated above the base flood elevation.

Cove Point and Long Beach are the two areas that are typically in danger of flooding in the County. Three properties are currently being elevated in the Cove Point subdivision. Two properties in Long Beach were identified for elevation but did not meet the benefit cost analysis. After Hurricane Isabel in 2003, a total of five properties had been identified for elevation and a total of 19 property owners applied for grants. Of this, only one property met the benefit cost analysis but the project was not pursued.

### Barriers

A barrier can be built of dirt or soil ("berm") or concrete or steel ("floodwall") and are used to prevent floodwaters from reaching a building. The standard design for earthen berms is three horizontal feet for each vertical foot (3:1 slope) requiring a minimum area six feet wide for each foot in height. Floodwalls need less room, but are more expensive. Barriers must be placed so as not to create flooding or drainage problems on neighboring properties, nor can they be constructed in the floodway. Depending on how porous the ground is, if floodwaters stay up for more than an hour or two, a barrier needs to handle leaks, seepage of water underneath, and rainwater that falls inside the perimeter. This is usually done with a sump and/or drain to collect the internal groundwater and surface water and a pump and pipe to pump the internal drainage over the barrier.

The Town of North Beach has floodwalls along both sides of Highway 261. The road is elevated for about 100 yards and separates the marsh from the bay.

### Dry and Wet Flood-proofing

The dry flood-proofing technique involves using measures to seal up a building so floodwaters are prevented from entering it. All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting and openings such as doors, windows, and vents are closed, either permanently, with removable shields, or with sandbags. Examples of dry flood-proofing modifications include the following:

- installing watertight shields over doors and windows;
- reinforcing walls to withstand floodwater pressures and impact forces generated by floating debris;
- using membranes and other sealants to reduce seepage of floodwater through walls and wall penetrations;
- installing drainage collection systems and sump pumps to control interior water levels, collect seepage, and reduce hydrostatic water pressures on the floor slab and walls;

- installing backflow valves to prevent the entrance of floodwater or sewage flows through utilities; and
- anchoring the building to resist flotation, collapse, and lateral movement.

Advantages

- The appearance of the building is not altered.
- It is appropriate for buildings on concrete slab floors (without basements) and for those without cracks.
- It is recommended where floodwaters are less than three feet and slow moving or for buildings that are too expensive to elevate (e.g., a slab building).

Disadvantages

- The waterproofing compounds can deteriorate over a period of time.
- It is dependent on human action for the installation of closures on windows and doorways.
- It cannot be used if the structure has a basement.

Wet flood-proofing, unlike dry flood-proofing, allows floodwaters to enter a structure. Wet flood-proofing is appropriate for structures with uninhabited areas below the flood elevation, such as unfinished basements, garages, and crawlspaces. Because wet flood-proofing allows floodwaters to enter a structure, modifications must be made to minimize damage to the portion of the structure below the flood elevation and its contents. Typically, the structure is designed so that walls and floors below the flood elevation are resistant to damage from floodwaters, and utilities and other valuable equipment are located above the flood elevation.

Wet flood-proofing is not feasible for one-story houses because the flooded areas are the living areas. However, basements, crawlspaces, garages, and accessory buildings can be wet proofed simply by relocating furnaces, heavy furniture and electrical outlets. Fuse and electric breaker boxes should be located high and near a door in order to safely turn the power off to the circuits serving flood prone areas.

No matter how little it is done, flood damage is reduced by wet proofing. For example, thousands of dollars in damage can be prevented by simply moving furniture and electrical appliances out of a basement.

## Sewer Backup Protection

In areas where sanitary and storm sewers are combined, basement flooding can be caused by storm-water overloading the system and backing up into the basement through the sanitary sewer line. In areas where sanitary flows and storm-water are carried in separate pipes, the same problem can be caused by cross connections between the sanitary and storm sewers or by infiltration or inflow into the lines.

Buildings that have downspouts, footing drain tile, and/or a sump pump connected to the sanitary sewer service may be flooded inside when heavy rains overload the system. If local code does not require these systems to be directly connected to the sewer system, they should be disconnected. Rain water and surface water should be directed out onto the ground where it will flow away from the building.

Other approaches may be used to protect a structure against sewer backup: floor drain plugs, floor drain stand-pipes, overhead sewers, and backflow protection valves. The first two devices keep water from flowing out of the lowest opening in the building, the floor drain. They cost less than $25. However, if water becomes deep enough in the sewer system, it can flow out of the next lowest opening, such as a toilet or tub, or it can overwhelm a drain plug by hydrostatic pressure and flow into the building through the floor drain. The other two measures are more secure, but more expensive ($3,000-$4,000). An overhead sewer keeps water in the sewer line during a backup. A backflow protection valve prevents backups from flowing into the building.

The County's Division of Water and Sewerage has never had a sewer backup protection program, and is not looking to implement one at this time. The sewer backup protection program is routinely implemented on the basis of individual users/customers.

The county-wide SCADA system (Mission Communications) performs a function of remotely monitoring all sewer pump stations that contacts county staff via cellular phone when any operational issues arise (high level in the wet wells, power failures, pump failure) that allow them to intervene if we have a failure at any pump station before the level gets high enough to either overflow the pump station and/or backup in the collection lines such that a backup would occur. This system only prevents backups that are a result of a pump station failure. Typically, any blockage that occurs upstream of the pump station wet wells cannot be detected or identified until such time that the water/sewage level in the sewer collection lines or service laterals rises to a point where it is observed at ground level (outside or inside of structures).

Sewer backup protection devices can be subject to failure due to clogging, especially if not regularly maintained, potentially causing more backups than would have occurred without the devices. Those that are installed inside in the basement would not be accessible to the County. Also, no other plumbing fixtures can be used in the house when the valve is in the closed position so, for example, during a hurricane, if the owner is not aware that the device is activated, they will have their own sewage back up into the house.

### Flood Insurance

With the purchase of flood insurance, as long as the policy is in force, the property is protected. Although most homeowner's insurance policies do not cover a property for flood damage, an owner can insure a building for damage by surface flooding through the National Flood Insurance Program.

Flood insurance coverage is provided for insurable buildings and their contents damaged by a "general condition of surface flooding" in the area. Building coverage is for the structure. This includes all things that typically stay with the building when it changes ownership, including: utility equipment (furnace or water heater); wall-to-wall carpeting; built-in appliances; and wallpaper and paneling.

Ten percent of a residence's building coverage may apply to a detached garage or carport. Other appurtenant structures are required to be insured under a separate policy. Contents coverage is for the removable items inside an insurable building. A renter can take out a policy with contents coverage, even if there is no structural coverage. Items not insurable include:

- items outside a building, such as fences, car ports, landscaping and driveways;
- jewelry, artwork, furs and similar items valued at more than $250;
- finished structural parts of a basement, such as paneling and wall to wall carpeting;
- animals and livestock;
- licensed vehicles;
- money or valuable papers; and
- contents in a basement.

In most cases, a 30-day waiting period follows the purchase of a flood insurance policy before it goes into effect. The objective of this waiting period is to encourage people to keep a policy at all times. People cannot wait for the river to rise before they buy their coverage.

Through the Basement Backup Insurance, the National Flood Insurance Program covers seepage and sewer backup for an additional deductible provided there is a general condition of flooding in the area which was the proximate cause of the basement becoming wet. Several insurance companies offer coverage for damage incurred should a sump pump fail or a sewer line backup. Most exclude damage from surface flooding that would be covered by the NFIP. Each company has different amounts of coverage, exclusions, deductibles, and arrangements. There is a need to encourage property owners in the 100-year floodplain to purchase flood insurance.

### *National Flood Insurance Program*

The National Flood Insurance Program (NFIP) is a Federal program that enables property owners in participating communities to purchase flood insurance as protection against flood losses, while requiring State and local governments to enforce floodplain management regulations that reduce future flood damages. The NFIP plays a critical role in encouraging communities to adopt and enforce floodplain management regulations and to implement broader floodplain management programs. Calvert County and its two municipalities participate in the Flood Insurance Program and allow property owners to purchase flood insurance through this program. The NFIP policies and premiums are administered by the County's Planning and Zoning Department. The County was initially involved in the Community Rating System from 1991 through 1996 as a Class 9 community. Based on information from the Maryland Department of the

Environment, several communities throughout the country retrograded to Class 10 when the Repetitive Loss Planning requirement was added in the 1990's. This included Calvert County.

**Table 4.1 Effective FIRM dates for local communities**

| Community Name | Current Effective Map Date |
|---|---|
| Calvert County (unincorporated areas) | July 20, 1998 |
| Town of Chesapeake Beach | November 1, 1984 |
| Town of North Beach | September 28, 1984 |

Source: FEMA Community Status Book Report, July 28, 2008

The loss and policy statistics for Calvert County have been included along with those for the individual municipalities for the period from January 1978 to September 2008. Calvert County incurs 1.9 percent of the total losses for the State of Maryland and 0.7 percent of the total policies.[3]

**Table 4.2 Calvert County loss statistics**

| Area | Losses | Total Payments |
|---|---|---|
| Maryland | 14,185 | $235,442,637.31 |
| Calvert County | 269 | $4,329,129.73 |
| Town of Chesapeake Beach | 64 | $1,548,029.55 |
| Town of North Beach | 94 | $2,615,266.18 |

**Table 4.3 Calvert County NFIP policy statistics**

| Area | Policies in Force | Insurance in Force | Whole Written Premiums in Force |
|---|---|---|---|
| Maryland | 68,241 | $13,505,442,300 | $32,812,163 |
| Calvert County | 508 | $130,483,600 | $349,955 |
| Town of Chesapeake Beach | 187 | $52,956,100 | $123,043 |
| Town of North Beach | 111 | $21,497,100 | $61,089 |

## Mandates

Mandates are compulsions that are used when incentives are inadequate to convince a property owner to take protective actions. An example of a mandate could include the improvements or repairs made to a building in the mapped floodplain. If the project is worth more than 50% of the value of the original building it is considered a "substantial improvement." The building must then be elevated or otherwise brought up to current flood protection codes.

The Floodplain Management Ordinance requires a one-foot freeboard above the base flood elevation. Utilities are required to be protected from higher flood levels. Electric and mechanical systems are required to be elevated to one foot above the base flood elevation and distribution panels are required to be elevated three feet above the base flood elevation.

[3] FEMA's Policy and Claim Statistics for Flood Insurance http://www.fema.gov/business/nfip/statistics/pcstat.shtm

# CHAPTER 5: EMERGENCY SERVICES

## Introduction

Emergency services involve measures to protect people during and after a disaster. In this Chapter, the following five types of emergency services measures are discussed: 1) Threat recognition; 2) Warning; 3) Response; 4) Critical facilities protection; and 5) Post-disaster recovery and mitigation.

## Threat Recognition

A flood threat recognition system provides early warning to emergency managers. The National Oceanic and Atmospheric Administration (NOAA) Weather Radio is considered the official source for weather information. Flood threat predictions are disseminated on the NOAA Weather Wire or NOAA Weather Radio.

NOAA typically uses two levels of notification in flood warning programs: 1) flood watch: conditions are right for flooding; and 2) flood warning: a flood has started or is expected to occur. Under certain conditions, the National Weather Service may issue a "flash flood watch." This means the amount of rain expected may cause rapid increases in local stream flows and/or localized ponding. However, these events are so localized and so rapid that a "flash flood warning" is seldom issued.

In the State of Maryland, all County Emergency Management Agencies are alerted by the Maryland Emergency Management Agency (MEMA). Warnings from the National Weather Service are relayed to municipalities by County Emergency Management Agencies (EMAs), who monitor weather radio and broadcast networks.

Calvert County's weather is forecasted by the National Weather Service located in Wakefield, Virginia. They provide daily updates on weather advisories; watches; and warnings. In the event of severe weather, up-to-date information is broadcast on local television channels and the following radio channels: WSMD 98.3 FM, WKIK 102.9 FM & 1560 AM, WPRS 104.1 FM, WYRX 97.7 FM, and WPTX 1690 and updated on the County's Emergency Management website. There are two USGS flood gauges in the County used to monitor flood levels. They are located on the Route 4 and Route 263 (Plum Point Road) stream and on the Route 4 and Parran Road stream.

## Warning

After a flood threat is recognized, the first priority is to alert others through the flood warning system. The second priority is to respond with actions that can prevent or reduce damage and injuries. The following responses to flood emergencies are undertaken by various agencies in the City and County:

Calvert County operates a CodeRED telephone emergency notification system that allows County staff to contact residents in the event of an emergency. CodeRED employs mapping capability for geographic targeting of calls coupled with a high-speed telephone system capable of delivering pre-recorded messages directly to homes and

businesses. In the event of extended power outages, staff use CodeRED to provide updates and broadcast emergency information such as warning center locations and mass care shelter activations.

The Emergency Management Department advocates the use of NOAA radios throughout the County. While the school system is equipped with NOAA radios, residents are also strongly encouraged to purchase these radios.

The County's website includes a link on what to do and where to go if residents are asked to evacuate: http://www.co.cal.md.us/residents/safety/emergency/evacuation/

## Response

An Emergency Operations or Response Plan identifies emergency planning, organization, and response policies and procedures and lays out details to address the integration and coordination with other governmental levels, during an emergency or when required. The Plan addresses how the jurisdictions will respond to extraordinary events or disasters from preparation through recovery. Emergency response plans should be updated annually to keep contact names and telephone numbers current and to ensure that supplies and equipment that will be needed are still available and revised after disasters based on the changing conditions. A well written Emergency Operations Plan (EOP) will contain information to enable emergency management staff to identify the number of properties flooded, roads that will be under water, critical facilities that will be affected. This information will enable staff to prepare a plan that shows problem sites and determines what resources will be needed to respond to the predicted flood level.

The Calvert County Emergency Management Agency is the entity responsible for planning and coordinating plans, procedures and resources in preparation for a natural or man-made disaster. Emergency management services at the State level are coordinated by the Maryland Emergency Management Agency. The County EMA is located at 175 Main Street in Prince Frederick which also contains the County's Emergency Communications Center. The EOC is located in the lower level of the north wing of the Courthouse, along with the Calvert Control (911 Center). The Emergency Operations Center is staffed during normal working hours and the County 911 Center is staffed 24/7. Upon activation of the EOC, 24-hour staffing is available through personnel assigned to EOC communications. An alternate EOC is located at the Prince Frederick Fire Department located on Route 2 and 4, at the intersection with Monitor Way, should the primary EOC become inoperable or unusable.

The ultimate responsibility for Emergency Management of any disaster rests with the Calvert County Board of Commissioners. The Board is responsible for all policy-level decisions which are implemented through the County Administrator. A Public Information Officer is responsible for preparing news releases and coordinating the release of information to the media and the public.

Annex A of the County's Emergency Operations Plan lays out the procedures to be used by the County's Emergency Management staff in the operation of the Emergency Operations Center during major emergency or disaster situations.

The Communications Annex (Annex B) provides information on communication capabilities during emergency situations when the Emergency Operations Center has been activated. The Annex identifies the organization and responsibilities of a number of agencies including the Emergency Management Agency; county departments with communication capabilities; Calvert Control; Fire, Rescue, and Police services; and Radio Amateur Civil Emergency Services.

Evacuation issues are addressed in Annex C of the County's EOP. The purpose of this Annex is to provide for an orderly and coordinated evacuation in the event of evacuations such as a riverine flood, hurricane, hazardous materials incident, fixed nuclear facility incident, major fire or transportation accident or terrorist attack. The measures considered for control and coordinating when planning for an evacuation include the geographic area; traffic control points; assembly points; and shelters.

Currently, there is no flood-specific response plan for Calvert County. However, since the County is subject to periodic hurricanes and since these hurricanes can produce events as high winds, heavy rainfall, storm surge, tornadoes, flooding or a combination of these, Annex O of the County's EOP – Hurricane Plan - establishes policies and procedures for direction and control during a hurricane emergency.

The Emergency Public Information Officer prepares public information releases to advise residents of areas affected and actions to be taken, i.e. assembly points for persons without private transportation, evacuation routes to be used, etc. and insures that current and accurate information is available for dissemination.

The County's Emergency Management website also provides a link to emergency management information: www.co.cal.md.us/residents/safety/emergency/ and to resources including state and federal agencies and the American Red Cross.

Table 5.1 indicates specific agencies within the County that are responsible for various aspects during a flood emergency situation.

**Table 5.1 Agency responsibilities for flood emergency responses**

| Action | Responsible Agency |
|---|---|
| Ordering an evacuation | Emergency Management in conjunction with the Board of County Commissioners |
| Activating the emergency operations center | Emergency Management |
| Opening and operating evacuation shelters | EOC activates the shelters if the Board of Education and Department of Social Services agree. Only schools with shower facilities (high schools) are used as shelters |
| Sandbagging certain areas | Property owners are primarily responsible for sandbagging with some assistance from Public Works. |
| Closing levee and floodwall systems | City of Chesapeake Beach |
| Closing streets or bridges | Public Works, Transportation, and Law Enforcement |
| Monitoring water levels at the high hazard dams which fall outside the city limits | Public Works, all bridges are privately owned |
| Shutting off power to threatened areas | Southern Maryland Electric Cooperative, BG&E |
| Releasing children from school | Board of Education |

## Critical Facilities Protection

Critical facilities are defined as those buildings or infrastructure that is vital to the functioning of a community and to the flood response effort. If a critical facility is flooded, workers and resources may be unnecessarily drawn away from protecting the rest of the community. If such a facility is adequately prepared, it will be better able to support the community's flood response efforts.

Critical facilities include emergency operations centers, police and fire stations, hospitals, and roads and bridges. Critical facilities also include those buildings or locations that, if flooded, would create secondary disasters such as hazardous materials facilities, water and wastewater treatment plants, pump stations, schools, and nursing homes.

The State Hazard Mitigation Plan identifies 22 state-owned facilities in Calvert County that are at risk from at least one hazard. The State Plan also identifies four critical and state-owned facilities that are at risk of at least four hazards: erosion, flood, surge, and radiological activity. These facilities include: the University of Maryland Center for Environmental Science, University of Maryland Chesapeake Biological Lab, University of Maryland Center for Environmental and Estuarine Studies, and University System of Maryland Warehouse. Calvert County has the second highest number of critical and state-owned facilities at risk in Maryland.

Based on data in the State Hazard Mitigation Plan, the counties surrounding the Chesapeake Bay have an increased risk of Category 1 Storm damage. Calvert County is home to 17 critical facilities at risk making up nine percent of all critical facilities at risk in Maryland. The total value at these 17 facilities is over $5.2 million.

**Table 5.2 Number and value of critical and state-owned facilities at extreme risk of tidal and coastal flooding from a Category 1 storm**

| Jurisdiction | Facilities | Value of Facilities | Value of Contents in Facilities | Total Value of Facilities |
|---|---|---|---|---|
| Calvert | 17 | $2,171,252 | $3,036,947 | $5,208,199 |
| Maryland Total | 186 | $93,633,509 | $116,002,283 | $209,635,792 |
| % of Total | 9.1 | 2.3 | 2.6 | 2.5 |

Calvert County is also among the jurisdictions with the greatest number of State-owned and critical facilities at-risk from a Category II Coastal Storm (other counties include Worcester, Dorchester and Somerset Counties). Calvert County accounts for seven percent of all the critical facilities at-risk from a Category II Costal Storm (total value of over $7 million).

**Table 5.3 Number and value of critical and state-owned facilities at extreme risk of tidal and coastal flooding from a Category 2 storm**

| Jurisdiction | Number of Facilities | Value of Facilities | Value of Contents in Facilities | Total Value of Facilities |
|---|---|---|---|---|
| Calvert | 18 | $2,961,994 | $4,131,158 | $7,093,152 |
| Maryland Total | 256 | $155,508,205 | $165,253,845 | $350,762,050 |
| % of Total | 0.7 | 1.9 | 2.5 | 2.0 |

## Post-Disaster Recovery and Mitigation

Post disaster recovery refers to steps taken by communities to prepare people and property after a disaster and for the next disaster. These activities are implemented during recovery to keep people from immediately going "back to normal" (i.e., the way they were before the disaster). While recovery operations follow a disaster, mitigation actions are undertaken when communities are in 'quiet' mode, prior to a disaster or several months after a disaster occurs in order to reduce the impact of a disaster.

Some examples of recovery actions include the following:

- Clearing streets;
- Cleaning up debris and garbage;
- Patrolling evacuated areas to prevent looting;
- Providing safe drinking water;
- Monitoring for diseases and vaccinating residents for diseases such as tetanus; and
- Regulating reconstruction to ensure that it meets all code requirements.

Some examples of mitigation actions include the following:

- Conducting a public information campaign to advise residents about various mitigation alternatives that could be considered;
- Assessing damage to public facilities and developing measures to mitigate hazards in the future;
- Acquiring substantially or repeatedly damaged properties from willing sellers; and
- Applying for post-disaster mitigation funds.

The Calvert County Emergency Management Agency ensures that the Federal, State and County activities are implemented with respect to emergency management procedures. The County's Emergency Operations Plan lists tasks and responsibilities of various entities in the County and its municipalities, during an emergency situation. If County resources prove to be inadequate during an emergency; assistance for equipment, supplies, and personnel may be obtained through the negotiated mutual-aid agreements with surrounding counties (Charles and St. Mary's Counties). The County has also developed working relationships with volunteer organizations in the incorporated communities and rural areas.

The Calvert County Emergency Operations Plan identifies actions to be taken by the government of Calvert County, Board of County Commissioners and by cooperating private organizations, to prevent disasters and to reduce the vulnerability of county residents to any disasters that may strike, to establish capabilities for protecting citizens from the effects of disasters, and to provide for recovery in the aftermath of any emergency involving extensive damage or debilitating influence on the normal pattern of life within the community. The Basic Plan and all 16 Annexes are working documents and are reviewed and revised on an ongoing basis.

The Basic Plan identifies the organizations and assigned responsibilities of a number of key personnel including the President of the Board of County Commissioners, Director of Emergency Management, Board of County Commissioners, Public Information Officer, Calvert Control, Fire Rescue EMS Coordinator, Fire Service, EMS Service, Police Department, Maryland State Police, Health Services, Social Services, School Board, Red Cross, and various County departments.

The 2004 Calvert County Hazard Mitigation Plan discussed in Chapter 3 was funded by FEMA and the Maryland Emergency Management Agency. The Plan provides recommendations for the mitigation of a number of different hazards including flood that pose a risk to the County's structures and residents

After a disaster, various types of assistance may be available to the County by local, state and federal governments. In the event of a Presidential disaster declaration, the County becomes eligible for Individual Assistance (IA) and Public Assistance (PA). Individual Assistance is typically funded by the US Small Business Administration and other federal, state, and local agencies that support the program and are designed to provide help to individuals and businesses, homeowners and renters, as they recover from disasters.

The Public Assistance program is largely funded by FEMA with local and state matches. The PA program provides cost reimbursement aid to local governments (state, county, local, municipal authorities, and school districts) and certain non-profit agencies that were involved in disaster response and recovery programs or that suffered loss or damage to facilities or property used to deliver governmental-like services.

Annex D – Damage Assessment Part II of the County's Emergency Operations Plan prescribes the procedures, responsibilities and actions to be taken by the Calvert County Emergency Management Agency and other County agencies in order to determine the extent and impact of damage caused by a manmade or natural disaster. These agencies include: Planning and Zoning, Public Works, Emergency Management, County Roads Department, Superintendent of Schools, Public Information Office, and American Red Cross, among others. Most post-disaster damage assessment efforts within the County are carried out cooperatively between the Emergency Management Agency and the Public Works Department. These entities, along with the Floodplain Administrator (Planning and Zoning) should be responsible for coordinating activities with the Flood Mitigation Steering Committee after a flood event, to ensure that the applicable mitigation actions are brought to the County Commission for potential implementation. This coordination should be reflected in the update of the County's Emergency Operations Plan.

# CHAPTER 6: STRUCTURAL PROJECTS

## Introduction

Structural projects such as reservoirs, levees and floodwalls, channel improvements, crossings and roadways, drainage and storm sewer improvements, and drainage system maintenance are designed to control floodwaters. Based on their sheer magnitude, structural flood control is generally the most expensive type of mitigation measure in terms of installation costs, maintenance requirements and environmental impacts. It, therefore, requires considerable thought and analysis before a structural project is selected. Since these projects often have regional or watershed-wide implications, they could be planned, funded and implemented by regional agencies such as watershed authorities. While flood control projects can be beneficial, they also have disadvantages.

Advantages

- Flood control projects can provide the greatest amount of protection for land area used.
- Due to land limitations, they may be the only practical solution in some circumstances.
- They can also be beneficial to the community for water supply and recreational uses.
- Regional detention may be more cost-efficient and more effective than requiring numerous small detention basins.

Disadvantages

- They disturb the land and disrupt natural water flows, often destroying wildlife habitat.
- They require regular maintenance in order to function properly.
- They are built to a certain flood protection level that can be exceeded by larger floods, causing extensive damage.
- They can create a false sense of security as people protected by a project often believe that no flood can ever reach them.
- They end up promoting more intensive land use and development in the floodplain.

## Reservoirs and Dams

Reservoirs control flooding by holding high flows behind dams or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate that the river can accommodate downstream. The lake created may provide recreational benefits or water supply (which could help mitigate a drought). Reservoirs are suitable for protecting existing development downstream from the project site. Unlike levees and channel modifications, they do not have to be built close to or disrupt the area to be protected. Reservoirs are most efficient in deeper valleys where there is more room to store water, or on smaller rivers where there is less water to store. Building a reservoir in flat areas and on large rivers may not be cost-effective, because large areas of land have to be

purchased. In urban areas, some reservoirs are simply manmade holes with the capacity to store floodwaters.

On the other hand, reservoirs and detention basins can have the following disadvantages:

- There is the threat of flooding to the protected area if the reservoir's dam fails;
- There is a constant expense incurred for management and maintenance of the facility;
- They may fail to prevent floods that exceed their design levels;
- Sediment deposition may occur and reduce the storage capacity over time;
- They can impact water quality as they are known to affect temperature, dissolved Oxygen, Nitrogen, and nutrients; and
- If not designed correctly, they may cause backwater flooding problems upstream.

There are no reservoirs in Calvert County. Storm water management ponds are evident throughout the county. The Victoria Station and Chesapeake Ranch Estate subdivisions contain large stormwater facilities.

The 2005 Maryland Hazard Assessment lists six dams in Calvert County[4]. All of the county's dams are of earthen construction. Five of the dams are rated as being in good condition. Bowen Farm Pond at the Battle Creek Cypress Swamp (low hazard) is rated in poor condition by MDE.

### Levees/Floodwalls

Earth barriers are termed as levees and concrete or steel barriers between the watercourse and the property to be protected are termed floodwalls. Levees occupy more space than floodwalls; therefore, when adequate space for a levee is not available, floodwalls are used, even though they are usually more expensive than levees. Levees and floodwalls may not be constructed in the floodway. Designs for both levees and floodwalls must provide for access through (e.g., watertight closures) or over (e.g., ramps or stairs) the barrier. In addition, the designs for both levee and floodwall projects must compensate for any loss of flood storage that will result from construction. There are no floodwalls in the unincorporated areas of the county. The Towns of North Beach and Chesapeake Beach each have a floodwall. Chesapeake Beach has a flood gate and sea wall. Both communities reported having revetment projects.

### Bridge Modifications

Modifications to bridges involve the replacement, enlargement, or removal of existing bridge decks at roadway and railway crossings. Often bridges are not large enough to pass flood flows, resulting in floodwater backing up upstream of the structure.

Highways and bridges are maintained by the County's Public Works Department. Table 6.1 identifies a total of 14 bridges. These bridges are inspected by professionals trained by the Maryland State Highway Administration every two years in accordance with State's Safety regulations.

[4] Data from MDE's Dam Inventory

**Table 6.1 Calvert County bridges**

| Bridge Number | Road | Water Crossing |
|---|---|---|
| C-0001 | Ward Road | Tributary of Hall Creek |
| C-0003 | Chaneyville Road | Graham Creek |
| C-0004 | Huntingtown Road | Cocktown Creek |
| C-0005 | Dalrymple Road | Fishing Creek |
| C-0006 | Hardesty Road | Fishing Creek |
| C-0007 | Cox Road | Sewell Branch |
| C-001 0 | Parran Road | St. Leonard Creek |
| C-0012P | Ball Road | St. Leonard Creek |
| C-0013 | Stinnett Road | Plum Point Creek |
| C-0014B | Stoakley Road | Mill Creek |
| C-0015B | Olivett Road | Old House Cove |
| C-0016 | Lower Marlboro Road (Wharf) | Patuxent River |
| C-0018B | German Chapel Road | Battle Creek |
| C-001 9 | Mill Branch Road | Tributary of Chew Creek |

Source: Calvert County Bridge/Structure Inventory and Postings – County Public Works Department

Two main bridges over the Patuxent River connect Calvert County to St. Mary's and Charles Counties: the Thomas Johnson Memorial Bridge at Solomons and the Route 231 Bridge at Hallowing Point. The Maryland State Highway Administration (SHA) is in the process of a planning study on MD Route 4 from MD Route 2 to MD Route 235. The project includes improvements to the MD 4 crossing of the Thomas Johnson Bridge. The purpose of the study is to address congestion and high traffic volume on the bridge particularly during peak periods.

## Channel Improvements

Channels can be improved by making them wider, deeper, or straighter. Improving channel conveyance causes more water to flow through it at a faster rate. However, channel ized streams could create or worsen flooding problems downstream as larger volumes of water are transported at a faster rate.

While channel improvements are one-time projects, they have to be maintained to clean out blockages caused by overgrowth or debris. Some communities also pass ordinances prohibiting dumping and making riverfront owners responsible for maintaining their areas. A proper maintenance program includes picking up debris as well as riparian restoration, i.e., removing non-native growth. By planting native grasses and plants, there are fewer sources of logs and woody debris, soils are better stabilized, bank erosion is reduced and habitat is improved.

The County's Department of Public Works conducts channel improvements and addresses all drainage issues. The Department is also in charge of clearing debris and carrying out routine maintenance throughout the year

## Dredging

Dredging is a form of conveyance improvement. Dredging may not be effective in most cases given the large volume of water that comes downstream during a flood, and so removing a foot or two from the bottom of the channel will have little effect on the height of the flood. Dredging is not a permanent improvement. Unless in-stream and/or tributary erosion are corrected upstream, the dredged areas usually fill back in within a few years, and the process and expense have to be repeated. In order to protect the natural values of the stream, Federal law requires a Corps of Engineers permit before dredging can proceed. This can be a lengthy process that requires much advance planning and many safeguards to protect habitat.

## Diversion

A diversion is a new channel that sends floodwaters to a different location, thereby reducing flooding along an existing watercourse. During normal flows, the water stays in the old channel. During flood flows, the floodwaters spill over to the diversion channel or tunnel, which carries the excess water to a receiving lake or river. Unless the receiving water body is relatively close to the flood-prone stream and the land in between is low and vacant, the cost of creating a diversion can be prohibitive. Where topography and land use are not favorable, a more expensive tunnel is needed. Sometimes diversions could cause new flood problems when diversion channels may be blocked by residents who do not understand, or disagree with, their purpose.

# CHAPTER 7: NATURAL RESOURCE PROTECTION

## Introduction

While open space is an amenity and serves the community in the form of parks, greenways, recreational opportunities, and golf courses, it also serves a beneficial function; it reduces the vulnerability to flooding when the floodplain is preserved as open space. Preserving floodplains, wetlands, and natural water storage areas enables the existing stormwater storage capacities of an area to be maintained. Open space can exist in the form of preserved open lands, purchased, or dedicated by developers in the form of easements.

Natural resource protection activities focus on preserving floodplains and watersheds, thereby improving their naturally beneficial functions. These functions include: storage of floodwaters, absorption of flood energy, groundwater recharge, removal/filtering of excess nutrients, pollutants, and sediments from floodwaters, habitat for flora and fauna, and recreational and aesthetic opportunities, among others. These measures are implemented by a variety of public and private parties ranging from local park districts, forest preserves and regulatory agencies to land developers and farmers. The following five natural resource protection activities are discussed below in light of reducing Calvert County's susceptibility to flood damage and also in improving the quality of life in the community: 1) wetland protection and forest conservation; 2) erosion and sedimentation control; 3) river restoration; 4) best management practices; and 5) dumping regulations.

## Wetland Protection and Forest Conservation

Wetlands are often found in floodplains and depression areas of a watershed and also serve as a natural filter to help improve water quality and provide healthy habitat for fish, plants, and wildlife. Wetlands receive and store floodwaters, thus slowing and reducing downstream flows and protect shorelines from erosion. Wetlands are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency under Section 404 of the Clean Water Act. Both these agencies are required to authorize individual permits. There are also nationwide permits that allow small projects that meet certain criteria to proceed without individual permits. The purpose of the permit is to protect wetlands by preventing development that would adversely affect them, and if that is indeed the case, wetlands are required to be mitigated. Wetland mitigation can include creation, restoration, enhancement or preservation of wetlands. The appropriate type of mitigation is addressed in each permit. Development regulations and educating property owners and local officials on the benefits are some ways to protect wetlands.

The County's wetlands are protected and regulated through the Maryland Department of the Environment. However, the County's wetland protection regulations are more stringent than that of the State's regulations. The County requires a 50-foot buffer around all non-tidal wetlands while the State only requires a 25-foot buffer. Filling of wetlands is prohibited for single-family dwellings except for unavoidable driveway or road crossings. All subdivision plats are required to show buffers.

Based on the County's floodplain ordinance, encroachment by developments in not allowed without State of federal permits. The applicant is required to demonstrate that no alternatives exist and that the encroachment is at the minimum amount necessary.

The Maryland Forest Service defines a buffer of at least 50 feet to be forested on each side of a stream with an increase of four feet for every one percent increase in slope. Article 8.3 of the County's Zoning Ordinance addresses forest conservation requirements. Any residential construction activity that does not result in the cumulative cutting, clearing, or grading of more than 30,000 square feet of forest on lots greater or equal to 40,000 square feet in size and 10,000 square feet of forest on lots less than 40,000 square feet in size of a forest the area is not subject to the requirements of a previous Forest Conservation Plan.

## Erosion and Sedimentation Control

Erosion occurs along stream banks and shorelines when the volume and velocity of flow or wave action destabilize and wash away the soil. Surface water runoff can erode soil from construction sites, sending sediment into downstream waterways. This sediment tends to settle down when the water flow slows down and can clog storm sewers, drain tiles, culverts and ditches and reduce the water transport and storage capacity of river and stream channels, lakes and wetlands. When channels are constricted and flooding cannot deposit sediment in the bottomlands, it results in clogged streams or increased dredging costs. These issues are addressed through sedimentation and erosion measures which include: phased construction, minimal land clearing, and stabilizing bare ground as soon as possible with vegetation and other soil stabilizing practices. Erosion and sedimentation control regulations mandate that these types of practices be incorporated into construction plans. They are usually oriented toward construction sites rather than farms. The most common approach is to require applicants to submit an erosion and sediment control plan for the construction project.

Erosion and sediment control practices are required to be in conformance with the 1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control published jointly by Water Resources Administration, Soil Conservation Service and State Soil Conservation Committee. Sediment and erosion control approval must be obtained from MDE if more than 5,000 square feet of surface area or more than 100 cubic yards is disturbed.

The County's Erosion and Sediment Control Ordinance requires all development in the floodplain to have a sediment control and stormwater management control permit. A grading permit and implementation of soil erosion and sediment controls is required for any development that results in disturbance greater than 5,000 square feet of land area and more than 100 cubic yards of earth, cut or fill.

## Best Management Practices

The term Best Management Practices (BMPs) refers to design, construction and maintenance practices and criteria that minimize the impact of stormwater runoff rates and volumes, prevent erosion, protect natural resources and capture nonpoint source pollutants (including sediment). In addition to preventing increases in downstream flooding and minimizing water quality degradation, BMPs preserve beneficial natural

features onsite, maintain natural base flows, minimize habitat loss, and provide multiple uses of drainage and storage facilities.

Point source pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. They are regulated by MDE. Non-point source pollutants come from non-specific locations and are harder to regulate. Examples of non-point source pollutants are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas and sediment from agriculture, construction, mining and forestry operations.

The County's Storm water Management Ordinance directly references the State's Stormwater and Design Manual which informs developers how to implement BMPS into their designs.

The County's Zoning Ordinance lists criteria for development in the Intensely Developed areas: In the case of new development, technologies are required to be used to minimize adverse impacts to water quality caused by stormwater. If these technologies do not reduce pollutant loadings by at least 10 percent below the level of pollution on the site prior to development, then offsets should be used to reduce pollutant loadings by at least 10 percent of the predevelopment levels by: 1) Installing a new BMP in an existing urbanized area not already served by a stormwater BMP; 2) Installing or financing an agricultural BMP in the Resource Conservation Area; and 3) Modifying an existing stormwater BMP to improve its pollutant removal capability.

### Dumping Regulations

While BMPs address pollutants that are liquids or suspended in water that are washed into a lake or stream, dumping regulations address solid matter, such as shopping carts, appliances and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Although these materials may not pollute the water, they can obstruct flows and reduce the channels' and wetlands' ability to convey or clean stormwater. Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. People may not realize the consequences of their actions and for example, may fill in the ditch in their front yard without realizing that it is needed to drain street runoff. Therefore, a dumping enforcement program could prevent this and help in educating people on the same.

# CHAPTER 8: PUBLIC INFORMATION

## Introduction

The public outreach and awareness aspect of flood mitigation involves the dissemination of pertinent information to residents, businesses, and local officials about hazards such as flooding. These actions are intended to educate the community and encourage them to be better prepared to face a hazard. Public information can be disseminated in many ways. The following six methods are discussed in this chapter: 1) Map information; 2) Library and websites; 3) Outreach projects; 4) Technical assistance; 5) Real estate disclosure; and 6) Educational programs.

## Map Information

FEMA's Flood Insurance Rate Maps provide valuable information about past and potential flood hazards and can help residents and businesses who are aware of the potential hazards to take steps to avoid problems and/or reduce their exposure to flooding. Flood maps are also to be used by real estate agents and potential home owners to determine if a property is flood-prone and whether flood insurance may be required.

Staff from Calvert County's Planning and Zoning Department (floodplain administrator) offer a walk-in service and assist residents by providing them with information on hazards, flooding outside of mapped areas, and zoning. They also explain flood insurance, property protection measures and mitigation options available to property owners. The Staff also assists in submitting requests for map amendments and revisions when needed, to show that a building is outside the mapped floodplain. FIRMs are available to the public at the County's Planning and Zoning Department.

## Library and Web Sites

The community library and local web sites are common places for residents to seek information on hazards, hazard protection, and protecting natural resources. Interested property owners can read or check out handbooks or other publications that cover their situation. Libraries also have their own public information campaigns with displays, lectures, and other projects, which can augment the activities of the local government. However, more recently, web sites have become popular as research tools as they provide quick access to a wealth of public and private sites and sources of information.

The Central Library is located on Costly Way in Prince Frederick. Branch libraries are located in Owings (Fairview Branch), Lusby (Southern Branch) Chesapeake Beach (Twin Beaches Branch). The County also has an Outreach Van that visits local agencies and institutions. The libraries stock flood-related books and publications. The libraries' website offers a search feature where flood related books, publications and DVDs may be viewed by typing the keywords on their website:
http://64.26.86.236/uhtbin/cgisirsi/OkCmVhCuMv/COMMINFO/198170056/60/1180/X

The Calvert County Emergency Management website offers a link to flood preparedness information on its homepage: http://www.co.cal.md.us/residents/safety/emergency/flood/

Information on how to prepare before, during, and after a flood is detailed on the site. Separate web pages are included for tornado, hurricane, and winter storm preparedness. The webpage also contains information on evacuation procedures.

## Outreach Projects

Outreach projects are designed to provide property owners information on property protection. Outreach materials may include funding sources, newspaper articles, flood protection techniques, etc. Other ways to disseminate information to the public include: displays in public buildings or shopping malls;

- articles and special sections in newspapers;
- radio and TV news releases and interview shows;
- flood protection video for cable TV programs or to loan to organizations;
- presentations at meetings of neighborhood groups, realtors, bankers, or other special interest groups;
- open houses that discuss flood-proofing techniques;
- web site notices with hyperlinks to other sources of information; and
- school curriculums on flood preparedness and flood safety.

Calvert County has offered outreach in the following forums: A workshop on floodplain management for surveyors and the public was conducted in July 2008 to fulfill a requirement for the forest conservation regulations; the annual Patuxent River Appreciation day is held by the County Environmental Commission where educational outreach activities are conducted; the County Environmental Commission writes articles on various topics for local newspapers; and the County's Emergency Management Department participates in some passive educational outreach through postings on their website and brochures. They also participate in community events and encourage residents to purchase NOAA radios.

The County Commissioners launched a monthly electronic email newsletter in July 2009. This is distributed via the internet to anyone subscribing via the initiation link on the county website (http://www.co.cal.md.us/). The principal use of the newsletter is for economic development but they will include other items of interest.

## Technical Assistance

Technical assistance is typically provided by experts such as the local floodplain manager or building department staff who offer free advice and guide residents. Some building department or public works staff visit properties and offer suggestions. Most can recommend or identify qualified or licensed companies, to assist homeowners who are unsure of the project or the contractor. Technical assistance can be provided in one-on-one sessions with property owners or can be provided through seminars or open houses on specific topics such as: retrofitting techniques, selecting qualified contractors, and carrying out preparedness activities.

Another effective technique is called a *flood audit*. This involves a flood expert to visit a flood prone site, locates past and potential (e.g., the 100-year) flood depths on the property, and discusses alternative protection measures with the owner. The owner is given a written report with recommendations and a photograph of the property showing flood depths.

The County's Floodplain Administrator provides technical assistance and advice on development projects that are proposed in the floodplain. The Planning and Zoning Department offers information to homeowners who are interested in retrofitting their homes.

## Real Estate Disclosure

In many instances, people feel, in hindsight, that they would have taken steps to protect themselves from a disaster such as a flood if they had known their property was in a flood-prone area. Based on Federal law, federally regulated lending institutions must advise applicants for a mortgage or other loan that is to be secured by an insurable building that the property is in a floodplain as shown on the Flood Insurance Rate Map. Flood insurance is required for buildings located within the base floodplain if the mortgage or loan is federally insured. However, because this requirement has to be met only 10 days before closing, often the applicant is already committed to purchasing the property when they first learn of the flood hazard.

Maryland Real Property Disclosure Act: *Effective October 1, 2005, a new Maryland law took effect that substantially affects residential real estate sales within the State. Under the new law, a seller of residential real property - unless otherwise exempt - would still be required to complete and deliver to the purchaser a disclosure or disclaimer statement. In addition to this, a seller - whether the seller elects to give the disclosure or disclaimer - is required to disclose to the purchaser, any latent defects of which the seller has actual knowledge. Under the new law, a latent defect is defined as material defects in real property or an improvement to real property that a purchaser would not reasonably be expected to ascertain or observe by a careful visual inspection of the real property and which would pose a direct threat to the health or safety of the purchaser or an occupant of the real property, including a tenant or invitee of the purchaser.*

In Calvert County, there is no real estate disclosure requirement at this time.

## Educational Programs

Environmental education programs can teach children about natural hazards, their cause and effect, and ways to be better prepared to face hazards, which can, in turn, be imparted to their parents. Assignments on developing an emergency kit for specific hazards can get parents interested and become involved in the exercises. Educational programs are typically undertaken by schools, park and recreation departments, conservation associations, and youth organizations, such as the Boy Scouts, Campfire Girls and summer camps.

The Board of Education and Chespax support environmental clubs in high schools county-wide. The County also has a recycling program.

# CHAPTER 9: GOALS AND OBJECTIVES

## Introduction

The Mitigation Strategy serves as the long-term roadmap for reducing potential losses identified in the earlier sections of the report. This Chapter identifies goals and objectives to help the County to be better prepared to face flooding and specific actions that should be implemented to reduce the community's vulnerability to flooding.

## Goals and Objectives

The goals and objectives form a basis upon which, specific mitigation actions will be developed. During the Steering Committee meetings held in March and April 2009 and the Public Meeting held in April 2009, citizens and local government representatives discussed the findings of the vulnerability assessment, its implications for flooding, and actions that needed to be taken to mitigate the flood risk to the unincorporated areas of the County as well as the municipalities. With this in mind, mitigation goals and objectives have been developed. For the purpose of this report, goals and objectives have been defined as the following:

- *Goals are general guidelines that explain what is to be achieved. They are usually broad policy-type statements, long term and represent global visions.*
- *Objectives define strategies or implementation steps to attain the identified goals. Unlike goals, they are more specific and measurable.*

The following goals and objectives developed in this Plan have been divided into the same six categories, as chapters 3 through 8 in the report: prevention; property protection; structural projects; natural resource protection; emergency services; and public information.

### *Prevention*

*Goal 1: Direct population concentrations away from known or predicted high flood hazard areas through appropriate regulations*

- Address hazard mitigation goals through existing plans and ordinances.
- Examine ordinance, and include language to ensure that any new development does not increase the vulnerability to flooding and make changes if required.
- Continue to ensure that the current building codes, floodplain ordinances, wetland protection, and erosion and sediment control standards are properly enforced.
- Consider a multi-objective management approach that promotes public involvement & coordination of floodplain management with other community concerns such as economic development, housing, water quality, and recreation.
- Ensure continued coordination and notification procedures between departments within the County and municipalities that are responsible for implementing flood mitigation activities.

***Property Protection***

*Goal 2: Ensure new construction and reconstruction is resistant to flood damage.*

- Encourage owners of high-risk, pre-FIRM residential structures to use retrofitting techniques to avoid repeated flooding.
- Support projects and programs to retrofit, relocate/acquire structures that are susceptible to repetitive flooding.
- Emphasize the importance of flood insurance to residents.

***Natural Resource Protection***

*Goal 3: Existing natural resources and open-space within the floodplain and watersheds should be protected.*

- Ensure all acquired properties are cleared and remain in public ownership in perpetuity.

***Emergency Services***

*Goal 3: Ensure continued coordination during emergencies.*

- Evaluate coordination and notification procedures.

*Goal 4: Ensure critical facilities are less vulnerable to flooding.*

- Identify appropriate mitigation techniques for critical facilities in the floodplain.

***Structural Projects***

*Goal 5: Reduce potential disruption of the County's infrastructure during hazard events.*

- Ensure regular maintenance of the County's critical facilities and infrastructure within the 100-year floodplain.

***Natural Resource Protection***

*Goal 6: Protect existing natural resources and open-space within the floodplain and watersheds.*

- On FEMA acquired properties (buy-outs), ensure all structures are removed and the property remains in public ownership in perpetuity.
- Consider best management practices for development in the 100-year floodplain.
- Encourage the maintenance and/or establishment of native vegetation in the floodplain.

***Public Information***

*Goal 7: Increase flood-awareness among county residents.*

- Involve community residents in the implementation of this Flood Mitigation Plan and in protecting their lives and property.
- Develop a coordinated outreach strategy to make citizens aware of and informed on flooding.

## Mitigation Actions

This section includes specific mitigation projects that have been derived from the goals and objectives in Chapter 9 that should be implemented over a period of time. The mitigation actions developed have once again been classified in the same six categories as are the goals and objectives. For each action item, the relevant issue and the goal(s) the action supports are identified. The agency or agencies responsible for implementation as well as applicable funding sources, an approximate cost, and general timeline for the implementation of each mitigation action are included. A detailed list of funding sources is provided at the end of this chapter. The abbreviations used below in the mitigation actions refer to the funding resources listed at the end of this chapter.

***Prevention***

Action 1a: Based on sea level rise and wave action, adopt a 2-foot minimum freeboard (currently 1 foot) above the Base Flood Elevation (BFE) for the county and municipalities.

Goal: 1
Responsible Agencies: Planning and Zoning
Possible Funding Sources: None required
Approximate Cost: Staff time
Timeline: 1-2 years

Action 2a: Review zoning density and restrict zoning to low density in 100-year floodplain (conservation, agricultural or large lot residential use) outside the town centers.
Action 2b: Consolidate the floodplain ordinance into the County's Zoning Ordinance.

Goal: 1
Responsible Agencies: Planning and Zoning
Possible Funding Sources: None Required
Approximate Cost: Staff time
Timeline: 1-2 years

Action 3: Emphasize the criticality in rejoining the CRS program. Hire a consultant to complete the CRS application and develop a template for future use.

Goal: 1
Responsible Agencies: Planning and Zoning
Funding Source: PDM
Approximate Cost: Consultant Fees
Timeline: 3-5 years

Action 4a: Riverine dFIRMs have been completed and coastal dFIRMs are underway. Incorporate coastal information once available and dFIRM information into future flood mitigation planning efforts.

Action 4b: Continue to require that recorded subdivision plats show the 100-year floodplain.
Goal: 1
Responsible Agencies: Planning and Zoning
Funding Source: None required
Approximate Cost: Not applicable
Timeline: 1-2 years

***Property Protection***

Action 5a: Consider elevation or acquisition of the identified repetitive loss properties in specific areas –all of Cove Point; and Mears Drive and Bayside Road in Chesapeake Beach.
Action 5b: Develop a comprehensive plan that identifies specific properties for acquisition, demolition, or flood-proofing of structures in Cove Point Beach, Lusby.
Goal: 2
Responsible Agencies: Public Works, Emergency Management Division, Housing Authority
Possible Funding Sources: FMA, PDM-C, SRL
Approximate Cost: To be determined
Timeline: 5+ years

Action 6: Consider lowering the threshold for cumulative substantial improvements from 50 percent to 40 percent so that more building projects meet the flood protection standards.
Goal: 2
Responsible Agencies: Planning and Zoning - Division of Inspections and Permits
Funding Source: None required
Approximate Cost: Staff time
Timeline: 1-2 years

Action 7: Identify uninsured property owners in known flood hazard areas and encourage them to purchase flood insurance.
Goal: 2
Responsible Agencies: Town Staff, Planning and Zoning
Funding Source: $10,000
Approximate Cost: Staff time
Timeline: 1-2 years

***Emergency Services***

Action 8a: Identify more state-of-the-art capabilities to provide emergency notifications to the public.
Action 8b: Ensure more complete notifications to the public throughout the county, particularly in the northern end of the county where sirens are ineffective.
Goal: 3
Responsible Agencies: Emergency Services
Possible Funding Sources: FMA, PDM-C, County Funds
Approximate Cost: $25,000-50,000
Timeline: 1-2 years

Action 9: Prepare a power-backup plan for county's critical facilities. Incorporate SMECO's Reliability Project to improve power service to the county.
Goal: 4
Responsible Agencies: Public Works
Possible Funding Sources: FMA, PDM-C, County Funds
Approximate Cost: $25,000-50,000
Timeline: 1-2 years

***Structural Projects***

Action 10: Continue to develop routine procedures that require examination of the potential for flood damage to a road, bridge, culvert, water line or sewer line as well as regular maintenance.
Goal: 5
Responsible Agencies: Public Works, Division of Inspections and Permits
Possible Funding Sources: PDM, FMA
Approximate Cost: Staff time
Timeline: 1-2 years

Action 11: Conduct a flood audit to identify ways to protect critical facilities in or near the 100-year floodplain: Industrial Park Wastewater Treatment Plant on Skipjack Road; Chesapeake Beach Wastewater Treatment Plant; North Beach Water Treatment Plant; North Beach Volunteer Fire Company; Our Lady Star of the Sea School; and Hallowing Point Station and Solomon's Police Station. The flood audit should include a review of the flood hazard at the site, low entry points, warning times, etc. as well as specific mitigation options to prevent future damage.
Goal: 5
Responsible Agencies: Public Works, Division Inspections and Permits, Planning and Zoning, Emergency Management
Possible Funding Sources: FMA, PDM
Approximate Cost: $100,000
Timeline: 5+ years

Action 12a: Elevate the entrance into the Cove Point neighborhood to allow easier access during emergency situations.
Action 12b: Investigate the possibility and feasibility of constructing a culvert with riser from the southwest corner of the Cove Point freshwater marsh to the Chesapeake Bay along Park Drive to mitigate flooding of Cove Point from freshwater sources.

Goal: 5
Responsible Agencies: Public Works, Division Inspections and Permits, Planning and Zoning, Emergency Management, Cove Point community
Possible Funding Sources: FMA, PDM for 12a and 12b; 12c and 12d would be privately funded by Dominion Cove Point LNG facility
Approximate Cost: >$150,000 Timeline: 5+ years

***Natural Resource Protection***

Action 13: Continue to implement BMPs during construction or as part of a project's design to permanently address nonpoint source pollutants. In addition to improving water quality, BMPs can have flood related benefits. By managing runoff, they can attenuate flows and reduce the peaks after a storm.

Goal: 6
Responsible Agencies: Planning and Zoning, Division of Inspections and Permits, Environmental Commission
Funding Sources: County funds
Approximate Cost: Staff time
Timeline: 1-2 years

***Public Information***

Action 14a: Prepare a presentation to demonstrate what happens when future adverse impacts caused by development are not accounted for, and the benefits of planning, improved mapping and regulatory standards.
Action 14b: Include information on hazards in the County's and municipalities' newsletters (Calvert Currents) as well as the County's website.
Action 14c: Conduct environmental and safety education programs to teach children about flooding, forces of nature, significance of protecting watersheds and floodplains and educate the floodplain property owners and elected officials.

Goal: 7
Responsible Agency: Public Information Office (Economic Development), Planning and Zoning, Emergency Management Division, Public Libraries
Possible Funding Sources: FMA, PDM
Approximate Cost: $40,000-$50,000
Timeline: 1-2 years

**Action 15: Continue to promote the use of NOAA radios as a source of immediate information by disseminating information at public meetings, community and senior centers, and citizen associations.**

Goal: 7
Responsible Agency: Public Information Office (Economic Development), Planning and Zoning, Emergency Management Division, Public Libraries
Possible Funding Sources: FMA, PDM
Approximate Cost: $40,000-$50,000
Timeline: 1-2 years

**Action 16: Conduct training sessions on the use of dFIRMs to stakeholder groups including planners, engineers, realtors, and community leaders.**

Goal: 7
Responsible Agencies: Planning and Zoning, Public Works
Funding Source: No funding required
Approximate Cost: Staff time
Timeline: 1-2 years

**Action 17a: Make dFIRMs available for download on the County website.**
**Action 17b: Develop a map website that allows users to determine their FIRM zone and other property information. Also consider adding links to gages to provide real-time water levels and national weather service flood crest predictions. Include additional data with aerial photographs and information on additional hazards, flooding outside mapped areas, and zoning and development regulations.**

Goal: 7
Responsible Agencies: Planning and Zoning, Technology Services Department
Possible Funding Sources: PDM, County Funds
Approximate Cost: $1 0,000-$1 5,000
Timeline: 1-2 years

**Action 18: Introduce public awareness and outreach activities related to floodplain management as part of the Patuxent River Appreciation Day activities.**

Goal: 7
Responsible Agencies: Environmental Commission, Parks and Recreation Division, Planning and Zoning
Possible Funding Sources: PDM
Approximate Cost: $10,000
Timeline: 1-2 years

***Municipality Recommendations***

Action 19a: For a property in North Beach, consider the following actions: a) install water equalizing vents to allow flooding without damage; and b) elevate all utilities above the Base Flood Elevation.
Action 19b: For properties on Mears Drive in Chesapeake Beach, consider the following actions: a) install water equalizing vents to allow flooding without damage; and b) elevate all utilities to upper floor level.
Action 19c: Consider acquisition and demolition of properties on Bayside Road in Chesapeake Beach. As a short-term option, install flood shields at all door openings and elevate all utilities above the Base Flood Elevation.
Goal: 5
Responsible Agencies: Public Works, Planning and Zoning, Emergency Management
Funding Source: HMGP, SRL, FMA, PDM
Approximate Cost: To be determined (will vary with the number of properties)
Timeline: 5+years

Action 20: Investigate the feasibility of constructing a flood wall or other flood protection measures in the Towns of Chesapeake Beach and North Beach that would protect the residential and commercial properties in the two towns.
Goal: 5
Responsible Agencies: Public Works, Division Inspections and Permits, Planning and Zoning, Emergency Management
Possible Funding Sources: FMA, PDM
Approximate Cost: >$1 50,000
Timeline: 5+ years

***Plan Implementation***

Action 21a: Work with the Flood Hazard Mitigation Steering Committee and members of the public who are interested in flood-related issues to implement this plan and review its progress.
Action 21b: Meet every six months to review projects that have been completed, altered, or are no longer applicable.
Action 21c: Update the Flood Mitigation Plan every five years and after a flood event.
Action 21d: Integrate this Plan into the All-Hazard Mitigation Plan as an annex.
Goal: All goals
Responsible Agencies: Planning and Zoning, Public Works
Funding Source: No funding required
Approximate Cost: Staff time
Timeline: 1-2 years

***Response to Public Comment***

**Action 22. Investigate flooding of Western Shores Blvd. with the Western Shores Citizen Association**

Goal: 3,5 and 7
Responsible Agencies: Planning and Zoning, Public Works, Public Safety
Funding Source: TBD
Approximate Cost: TBD
Timeline: 1-2 years

## Funding Sources

The following funding sources provide grants for flood mitigation planning and project related activities:

- Hazard Mitigation Grant Program (HMGP) – HMGP is administered by FEMA and provides grants to states, tribes and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation activities to be implemented as a community recovers from a disaster. Eligible projects include: elevating flood-prone homes or businesses; acquisition of flood-prone homes from willing owners and returning the property to open space; retrofitting buildings; and construction of floodwall systems to protect critical facilities.

- Pre-Disaster Mitigation (PDM) Program – The PDM program provides funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. The program provides technical and financial assistance to States and local governments to assist in the implementation of pre-disaster mitigation actions, which must be cost-effective and designed to reduce injuries, loss of life and damage and destruction of property.

- Flood Mitigation Assistance (FMA) Program – FMA provides funding to assist communities and states in implementing actions that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, or other National Flood Insurance Program (NFIP) insurable structures with a focus on repetitive loss properties. The NFIP enables property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. Three types of FMA grants are available to States and communities: 1) planning grants to prepare Flood Mitigation Plans; 2) project grants to implement measures to reduce flood losses, such as elevation, acquisition, or relocation of NFIP-insured structures; and 3) technical assistance grants for the State to help administer the FMA program and activities.

- Repetitive Flood Claims – The program provides funding to States and communities to reduce or eliminate the long-term risk of flood damage to structures insured under the NFIP that have had one or more claims for flood damages, and that cannot meet the requirements of the Flood Mitigation Assistance (FMA) program for either cost share or capacity to manage the activities. Eligible activities include: 1)acquisition of properties and either demolition or relocation of flood-prone structures, where the property is deed restricted for open space uses in perpetuity; 2) elevations; 3) dry flood-proofing of non-residential structures; and 4) minor localized flood control projects.

- Severe Repetitive Loss (SRL) - A SRL property is defined as a residential property that is covered under a NFIP flood insurance policy and: 1) that has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or 2) for which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building. Eligible flood mitigation project activities under the SRL program include: 1) acquisition and demolition or relocation of at risk structures and conversion of the property to open space; 2) elevation of existing structures to at least the base flood elevation; 3) minor physical localized flood reduction projects; and 4) dry flood-proofing for historic properties.

- Emergency Management Performance Grants (EMPG) – The EMPG program provides resources to state and local governments to develop an all-hazards planning approach to emergency management and to sustain and enhance all-hazards emergency management capabilities.

Most State and Federal grant programs require local communities to provide at least part of the necessary project funding in real dollars or through "in-kind" services. While the percentage of local contribution varies from program to program, Local communities need to assess their financial capability and resources to implement their hazard mitigation action plans.

# CHAPTER 10 - PRIORITIZATION

Once the mitigation actions were finalized by the Hazard Mitigation Steering Committee, mitigation actions were ranked based on the following evaluation criteria. The following questions were taken into consideration while evaluating each factor:

***Social Considerations – Life/Safety Impact***

- Will the project have minimal/direct/or significant impact on the safety of businesses, residents, and properties?
- Will the proposed action adversely affect one segment of the population?
- Will the project be a proactive measure to reducing flood risk?

***Administrative Considerations – Administrative/Technical Assistance***

- Is there sufficient staff currently to implement the project?
- Is training required for the staff to implement this project?

***Legal Considerations – Statutory Requirements***

- Does the action satisfy a statutory requirement?
- Does the action improve data collection and storage?

***Economic Considerations – Project Cost***

- What is the approximate cost of the project?

These considerations were then grouped into low, medium, and high categories and assigned points: low - 3 points; medium - 5 points; and high - 10 points. Timelines for these projects were also established as to when the projects would be initiated: Short range projects – implemented within first 2 years; medium range projects - 3 to 5 years; and long range projects – over 5 years.

**Table 10.1 Evaluation criteria for project ranking**

| Evaluation Criteria | Evaluation Value | | |
|---|---|---|---|
| | Low (L) 3 points | Medium (M) 5 points | High (H) 10 points |
| **Life/Safety Impact** | Minimal/negligible number of businesses, residents, properties affected by action. | Moderate number of businesses, residents, properties affected by action. | Significant number of businesses, residents, properties affected by action. |
| **Administrative/Technical Assistance (staffing, funding, maintenance)** | No staff and/or training required to implement project. | Some staff staff/training required to implement project. | Significant staff/training needed to implement project. |
| **Statutory (codes, plans, ordinances)** | Does not satisfy a statutory requirement or requires a change to the code. | May require a change to the code but action improves data collection and storage. | Satisfies a statutory requirement or does not require a change to the code. Action may improve data collection and storage. |
| **Project Cost** | >$250,000 | $50,000 to $250,000 | <$50,000 |

**Table 10.2 Ranking of flood mitigation actions**

| Action No. | Project Description | Life/ Safety Impact | Admin/ Tech Support | Statutory Implications | Cost | Total Score | Timeline |
|---|---|---|---|---|---|---|---|
| 1a/1b | Based on sea level rise and wave action, adopt a 2-foot minimum freeboard (currently 1 foot) above the BFE for the county and municipalities.<br>Adopt a 3-foot minimum above the base flood elevation for all distribution panel boxes, outlets and electrical installations. | 10 | 10 | 3 | 10 | 33 | S |
| 2a/2b | Review zoning density and restrict zoning to low density in the 100-year floodplain (conservation, agricultural or large lot residential use) outside the town centers.<br>Consolidate the floodplain ordinance into the County's Zoning Ordinance. | 10 | 10 | 3 | 10 | 33 | S |
| 3 | Emphasize the criticality in rejoining the CRS program. Hire a consultant to complete the CRS application and develop a template for future use. | 5 | 3 | 10 | 10 | 28 | M |
| 4a/4b | Riverine dFIRMs have been completed and coastal dFIRMs are underway. Incorporate coastal information once available and dFIRM information into future flood mitigation planning efforts.<br>Continue to require that recorded subdivision plats show the 100-year floodplain. | 5 | 5 | 10 | 10 | 30 | S |
| 5a/5b | Consider elevation or acquisition of the identified repetitive loss properties in specific areas – all of Cove Point; and beach Street in Cove Point Beach, Lusby; and Mears Drive and Bayside Road in Chesapeake Beach.<br>Develop a comprehensive plan that identifies specific properties for acquisition, demolition, or flood-proofing of structures in Cove Point Beach, Lusby. | 10 | 5 | 10 | 3 | 28 | L |

| | Project Description | Life/ Safety Impact | Admin/ Tech Support | Statutory Implications | Cost | Total Score | Timeline |
|---|---|---|---|---|---|---|---|
| 6 | Consider lowering the threshold for cumulative substantial improvements from 50 percent to 40 percent so that more building projects meet the flood protection standards. | 3 | 10 | 3 | 10 | 26 | S |
| 7 | Identify uninsured property owners in known flood hazard areas and encourage them to purchase flood insurance. | 5 | 5 | 10 | 10 | 30 | S |
| 8a/8b | Identify more state-of-the-art capabilities to provide emergency notifications to the public.<br>Ensure more complete notifications to the public throughout the county, particularly in the northern end of the county where sirens are ineffective. | 10 | 5 | 10 | 10 | 35 | S |
| 9 | Prepare a power-backup plan for county's critical facilities. Incorporate SMECO's Reliability Project to improve power service to the county. | 3 | 5 | 10 | 10 | 28 | S |
| 10 | Continue to develop routine procedures that require examination of the potential for flood damage to a road, bridge, culvert, water line or sewer line as well as regular maintenance. | 3 | 3 | 10 | 10 | 26 | S |
| 11 | Conduct a flood audit to identify ways to protect critical facilities in or near the 100-year floodplain: Industrial Park Wastewater Treatment Plant on Skipjack Road; Chesapeake Beach Wastewater Treatment Plant; North Beach Water Treatment Plant; North Beach Volunteer Fire Company; Our Lady Star of the Sea School; and Hallowing Point Station and Solomon's Police Station. The flood audit should include a review of the flood hazard at the site, low entry points, warning times, etc. as well as specific mitigation options to prevent future damage. | 3 | 3 | 10 | 3 | 19 | L |
| 12a/12b/ | Elevate the entrance into the Cove Point neighborhood to allow easier access during emergency situations.<br>Investigate the possibility and feasibility of constructing a culvert with riser from the southwest corner of the Cove Point freshwater marsh to the Chesapeake Bay along Park Drive to mitigate flooding of Cove Point from freshwater sources. | 5 | 5 | 3 | 3 | 16 | L |

| Action No. | Project Description | Life/ Safety Impact | Admin/ Tech Support | Statutory Implications | Cost | Total Score | Timeline |
|---|---|---|---|---|---|---|---|
| 13 | Continue to implement BMPs during construction or as part of a project's design to permanently address nonpoint source pollutants. In addition to improving water quality, BMPs can have flood related benefits. By managing runoff, they can attenuate flows and reduce the peaks after a storm. | 3 | 5 | 3 | 10 | 21 | S |
| 14a/14b/ 14c | Prepare a presentation to demonstrate what happens when future adverse impacts caused by development are not accounted for, and the benefits of planning, improved mapping and regulatory standards.<br>Include information on hazards in the County's and municipalities' newsletters (Calvert Currents) as well as the County's website.<br>Conduct environmental and safety education programs to teach children about flooding, forces of nature, significance of protecting watersheds and floodplains and educate the floodplain property owners and elected officials. | 10 | 5 | 10 | 10 | 35 | S |
| 15 | Continue to promote the use of NOAA radios as a source of immediate information by disseminating information at public meetings, community and senior centers, and citizen associations. | 10 | 5 | 10 | 10 | 35 | S |
| 16 | Conduct training sessions on the use of dFIRMs to stakeholder groups including planners, engineers, realtors, and community leaders. | 3 | 5 | 10 | 10 | 28 | S |
| 17a/17b | Make dFIRMs available for download on the County website.<br>Develop a map website that allows users to determine their FIRM zone and other property information. Also consider adding links to gages to provide real-time water levels and national weather service flood crest predictions. Include additional data with aerial photographs and information on additional hazards, flooding outside mapped areas, and zoning and development regulations. | 3 | 5 | 3 | 10 | 21 | S |
| 18 | Introduce public awareness and outreach activities related to floodplain management as part of the Patuxent River Appreciation Day activities. | 10 | 5 | 10 | 10 | 35 | S |

| Action No. | Project Description | Life/ Safety Impact | Admin/ Tech Support | Statutory Implications | Cost | Total Score | Timeline |
|---|---|---|---|---|---|---|---|
| 19a/19b/ 19c | For a property in North Beach, consider the following actions: a) install water equalizing vents to allow flooding without damage; and c) elevate all utilities above the Base Flood Elevation.<br>For properties on Mears Drive in Chesapeake Beach, consider the following actions: a) b) install water equalizing vents to allow flooding without damage; and c) elevate all utilities to upper floor level.<br>Consider acquisition and demolition of properties on Bayside Road in Chesapeake Beach. As a short-term option, install flood shields at all door openings and elevate all utilities above the Base Flood Elevation. | 5 | 5 | 10 | 3 | 23 | L |
| 20 | Investigate the feasibility of constructing a flood wall in the Towns of Chesapeake Beach and North Beach that would protect the residential and commercial properties in the two towns. | 3 | 5 | 10 | 3 | 21 | L |
| 21a/21b/ 21c/21d | Work with the Flood Hazard Mitigation Steering Committee and members of the public who are interested in flood-related issues to implement this plan and review its progress.<br>Meet every six months to review projects that have been completed, altered, or are no longer applicable.<br>Update the Flood Mitigation Plan every five years and after a flood event.<br>Integrate this Plan into the All-Hazard Mitigation Plan as an annex. | 3 | 5 | 10 | 10 | 28 | S |
| 22 | Investigate flooding of Western Shores Blvd. with Western Shores Citizen Association | 10 | 3 | 3 | 5 | 21 | S |

## High-Priority Actions

The actions listed below received the highest scores based on the ranking.

- Review zoning density and restrict zoning to low density in the 100-year floodplain (conservation, agricultural or large lot residential use) outside the town centers. Consolidate the floodplain ordinance into the County's Zoning Ordinance.
- Identify more state-of-the-art capabilities to provide emergency notifications to the public.
- Ensure more complete notifications to the public throughout the county, particularly in the northern end of the county where sirens are ineffective.
- Prepare a presentation to demonstrate what happens when future adverse impacts caused by development are not accounted for, and the benefits of planning, improved mapping and regulatory standards. Include information on hazards in the County's and municipalities' newsletters as well as the County's website. Conduct environmental and safety education programs to teach children about flooding, forces of nature, significance of protecting watersheds and floodplains and educate floodplain property owners and elected officials.

- Continue to promote the use of NOAA radios as a source of immediate information by disseminating information at public meetings, community and senior centers, and citizen associations.
- Introduce public awareness and outreach activities related to floodplain management as part of the Patuxent River Appreciation Day activities.

## Plan Maintenance

Once this Plan has been reviewed by the Maryland Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA), the Plan will be adopted by the Calvert County Board of County Commissioners. Since the Plan is envisioned to be a 'living document', plan adoption is not considered the final step in the planning process but rather as a first step to implementation. The plan monitoring and maintenance schedule is a cycle of events that involves periodic review, adjustments, and improvement. This section establishes a method to monitor how the Plan will be evaluated and maintained in the future.

In order to ensure that the Plan continues to provide a framework for reducing the flood risk to the County, the Planning and Zoning Department will take responsibility to convene an annual meeting of the Hazard Mitigation Steering Committee. At this meeting, the Steering Committee will determine the status of each mitigation action. Each action proposed in the Mitigation Plan will be categorized as one of the following: completed, in progress, not started/delayed, modified, or cancelled. The Steering Committee will assist the Planning and Zoning Department in preparing a status report of the mitigation actions.

In addition to conducting an annual review of the Plan, the Steering Committee will review the Plan within 30 days after a flood event. Each goal and objective will be examined for its relevance and its validity to the changing situation in the County, and the mitigation actions will be reviewed to ensure that they address any recent issues that may have stemmed from the disaster.

# APPENDIX 1

## Steering Committee Materials

**Calvert County**
**FLOOD MITIGATION PLAN**

**Mitigation Core Team Meeting #1**
**13 November 2008**
**1 0am-Noon**
**AGENDA**

**Introductions – Steve Kullen**

- **County Staff**
- **Mitigation Core Team Members**
- **Consultants**
  - **Deepa Srinivasan, Vision Planning and Consulting**
  - **Dr. Mike Scott, ESRGC**

**PowerPoint Presentation – Deepa Srinivasan and Dr. Mike Scott**

- **FMA Plan Requirements**
- **Overview of the Hazard Mitigation Planning Process**
- **Schedule**
- **Requested Information**

**Discussion - Group**

- **Hazard Identification and Risk Assessment**
- **Mitigation Capability Analysis and Distribution of Questionnaires**

**Wrap-up – Deepa Srinivasan**

- **Next steps**
- **Schedule Mitigation Core Team Meeting #2**
- **Questions**

**Adjournment**

## Flood Mitigation Plan
## Calvert County, MD

VISION

## Project Purpose

*To develop a flood mitigation plan to improve Calvert County's resistance to floods by identifying actions to reduce the impact of floods to county residents and structures*

## Key Players

- Calvert County Staff
- Flood Mitigation Plan Steering Committee
- Municipal Representatives
  - North Beach, Chesapeake Beach
- Consultants
  - Deepa Srinivasan, President, Vision Planning & Consulting
  - Dr Mike Scott, Director, Eastern Shore Regional GIS Cooperative @ Salisbury University
- Public
- Maryland Emergency Management Agency (MEMA)
- Federal Emergency Management Agency (FEMA)

## Project Goals

- The Flood Mitigation Plan for Calvert County will:
  - Be consistent with the requirements of the 44 Code of Federal Regulations part 78.5 Flood Mitigation Plan Development;
  - Help reduce the risk of loss of life, personal injury and property damage to the County's residences and businesses by identifying the flood risk,
  - Include mitigation strategies to address the flood risk within the County, and
  - Gain approval from the MEMA and FEMA, paving the way for future federal funding of flood mitigation projects.

## [illegible] Mitigation Plan Requirements

- Describe the planning process
- Describe public involvement
- Include existing flood risk
- Include number of estimated structures in the floodplain
- Identify repetitive loss structures
- Identify extent of flood depth and damage potential
- Discuss floodplain management goals
- Identify and evaluate feasible mitigation actions
- Present a strategy for reducing flood risks
- Provide a strategy for continued compliance with NFIP
- Describe procedures for ensuring implementation, reviewing progress, and making revisions
- Provide documentation of Plan by legal authority

## Steps in the Planning Process

- Organize steering committee and process (meetings)
- Assess hazards, risks, vulnerability
- Assess local capabilities
  - Existing Plans, Programs, Policies
  - Personnel and Equipment Resources
  - Local Codes and Zoning Ordinances
  - Current and Proposed Construction Projects

## Steps in the Planning Process (cont'd)

- Develop goals and objectives and mitigation actions
  - Prevention
  - Property Protection
  - Public education and Awareness
  - Natural Resource Protection
  - Emergency Services
  - Structural Projects
- Write mitigation plan and prioritize projects (Evaluation Criteria STAPLEE)
  - Social
  - Technical
  - Administrative
  - Political
  - Legal
  - Economic
  - Environmental

## Steps in the Planning Process (cont'd)

6 Develop implementation plan
- Priorities for Mitigation Actions
  - Short-, Medium-, or Long-Range
  - Potential Funding Sources
  - Responsible Entities
  - Target Completion Dates
- Five-Year Plan Maintenance Cycle

## Meetings

- 4 Steering Committee Meetings
  - Meeting 1 Planning process, schedule, deliverables, capability assessment
  - Meeting 2 Hazard identification, risk assessment
  - Meeting 3 Goals and objectives, Mitigation actions
  - Meeting 4. Mitigation actions prioritization and implementation

  2 Public Meetings
  - Meeting 1
    - Planning process
    - Hazard identification, risk assessment, capability assessment
  - Meeting 2
    - Goals and objectives
    - Mitigation actions and implementation

## Hazard Identification and Vulnerability Assessment

- Definitions
  - Hazard – the threat to things we value
  - Risk – the probability the hazard might occur
  - Vulnerability – the potential for loss
  - Mitigation Capability – the degree of ability to either remove the threat or to resist and/or recover from a hazard event

## Hazard Identification and Vulnerability Assessment

- Seek to determine for the 100-year coastal/riverine event:
  - Where will it flood?
  - How deep will the floodwater likely be?
  - Which structures are likely to be impacted?
  - What is the value of those structures and their contents?
  - What is the likely damage to occur from a 100-year event?
- 100-year flood – has a 1% chance of happening every year
- Also, seek to inventory known or suspected stormwater flooding issues/locations

## Hazard Identification and Vulnerability Assessment

- Determined using:
  - Flood insurance rate maps (FIRMs) - both old and new
  - Most recent flood modeling software (HAZUS-MH) developed by FEMA
  - The best data available
    - USACE, MDNR, MDP, MDAT, MDE, County/City Planning
    - All the data has been compiled
    - A GIS-based spatial analysis
    - Digital mapping and analysis system
  - Input from local experts

## Hazard Identification and Vulnerability Assessment

- Method and Approach
  - Collect all necessary data
    - Air photos, LiDAR, building locations, FIS FIRMs, etc
  - Field check all structures in the floodplain for construction types and foundation height
  - Realign FIRMs and create new interpolated cross sections, if necessary
  - Use the FIS to inform flood heights
  - Input all data to HAZUS-MH model
  - Display results

## Capability Assessment

- Calvert County Plans
  - 2004 Comprehensive Plan Calvert County, 2004
  - 2004 County Hazard Mitigation Plan, 2004
  - Water Resources Update (update to Comp. Plan) October 2009
  - County Land Preservation, Parks and Recreation Plan, 2006
  - County Water and Sewage Plan, 2008

## Capability Assessment

- Calvert County Ordinances
  - County Floodplain Management Ordinance, 1992
  - Calvert County Zoning Ordinance, 2006 (rev June 2008)
    - Residential Development Requirements – Article 5
    - Subdivision Regulations – Article 7
    - Environmental Requirements – Article 8
    - Shore Erosion Protection Works – Article 9-8

## Summary of Hazards and Risk

- Flood Related Hazards and their Level of Risk
  - (Maryland Hazard Analysis 2004)
  - (Calvert County Hazard Mitigation Plan 2004)

| Flood Related Hazards | Maryland Hazard Analysis 2004 | Calvert County Hazard Mitigation Plan 2004 |
|---|---|---|
| Tidal/coastal flooding | Medium-high | High |
| Flash floods | Medium-low | High |
| Riverine flooding | Low | High |
| Hurricane/tropical storms | Medium | High |
| Storm surge | Medium-low | |
| Heavy rain | Medium-low | |

## Capability Assessment

- Flooding Highlights
  - Most of 100-year floodplains in County located in the western side of the county, along Patuxent River and tributaries
  - Most vulnerable areas are near Battle, Hunting, & Hall Creeks
  - Most areas bordering the Chesapeake Bay protected from flooding by the bluffs that characterize this portion of Bay's western shore. Exceptions include low-lying areas near Cove Point, Long Beach, Parker's Creek, and upper North Beach.
  - Approximately 22 sq.m (5%) of County's total land area (225 sq m) lie within 100-year floodplains

Source: 2004 Maryland State Hazard Analysis, Chap 32

## Capability Assessment

- **Storm Surge Inundation Highlights**
  - Bluffs along the Chesapeake Bay offer protection to most shorelines on the eastern side of the county, though parts of Chesapeake Beach and North Beach are exposed to storm surge.
  - Low-lying areas adjacent to creeks and portions northwestern Calvert County along the Patuxent River also vulnerable.

Source: 2004 Maryland State Hazard Analysis, Chap 32

## Capability Assessment

- Floodplain ordinance requires elevation certificates to show elevated structures to or above BFE.
- Public facilities cannot be located within the Farm Community District or Resource Preservation District.
- Watershed plans complete for Parkers creek and Huntingdon and will be completed for all major tributaries in the county.
- Stormwater studies have been conducted for Town Centers

## Capability Assessment

- County works with MDE on joint inspections of sites involving site grading and stormwater management construction.
- County plans to restore or create wetlands in disturbed areas

## Capability Assessment

- County mitigates future flood losses through its Subdivision Regulations, Floodplain Management Ordinance, and Building Code
  - Floodplain ordinance for Calvert County has a freeboard requirement of 1 feet above base floor elevation in the 100-year floodplain
  - County participates in the NFIP and allows property owners to purchase flood insurance through this program
  - Building Code has wind loading requirements for new structures and tie-down requirements for mobile homes

## Capability Assessment

1992 Floodplain Management Ordinance

- In all floodplain zones, all development that proposes to alter a watercourse must get a variance.
- If a development activity is proposed in a non-tidal floodplain for drainage areas of more than 400 acres, a waterway construction permit is required from the State
- Any land disturbance permitted in the floodplain must have a stormwater management and S&E control plan
- All new or substantially improved structures should have the lowest floor elevated at or above the FPE
- Manufact homes not permitted in coastal high hazard area

## Capability Assessment

- Recommended Flood Related Mitigation Projects - Calvert County Hazard Mitigation Plan (2004)
  - Encourage uninsured property owners in known flood hazard areas to purchase flood insurance
  - Update FIRMs to include previously unmapped areas and additional BFEs
  - Ensure regular maintenance of county owned bridges
  - Establish a partnership with NWS to enhance existing flood forecast & warning system via the Advanced Hydrologic Prediction Services Program
  - Make FIRMs and FIS available for public inspection
  - Prepare a power-back up plan for county's critical facilities
  - Increase number of NOAA radios in public places across the county
  - Provide adequate shelters with backup power, in various parts of the county to serve as refuge areas during floods and other hazards

## Capability Assessment

**National Flood Insurance Program Participants**

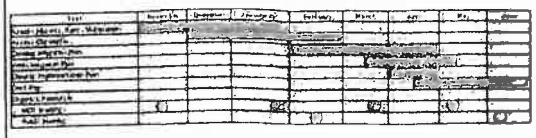
| Calvert County | |
|---|---|
| Community Name | Curr ER Map Date |
| [illegible] | 1/20/1978 |
| [illegible] | 1/11/1984 |
| [illegible] | 8/20/1984 |

Source: FEMA Community Status Book Report, 03/18/08

## Capability Assessment

- Calvert County Departments
  - Planning and Zoning Department
  - Economic Development Department
  - Emergency Management Division
  - Fire, Rescue, and Emergency Medical Services Division
  - Housing Authority
  - Parks and Recreation Division
  - Environmental Commission
  - Public Safety Department
  - Public Works Department
  - Transportation Department
  - Division of Inspections and Permits

## Schedule



## Next Steps

- Data Collection
- Hazard Identification and Risk Assessment
- Review of Plans and Ordinances
- Mitigation Capability Assessment
- Steering Committee Meeting #2 (Mid January 2009)

## Thank You!

Calvert County
**FLOOD MITIGATION PLAN**

Mitigation Core Team Meeting #2
31 March 2009
1:30-3:30pm
**AGENDA**

Introductions
- County Staff
- Steering Committee Members
- Consultants
  - Dr. Mike Scott, ESRGC

PowerPoint Presentation – Dr. Mike Scott
- Hazard Identification
- Modeling Results
- Vulnerability Assessment

Discussion - Group
- Hazard Identification and Risk Assessment
- Mitigation Capability Analysis and Discussion of Questionnaire

Wrap-up – Dr. Mike Scott
- Next steps
- Questions

Adjournment

## 2nd MCT Meeting: Hazard and Vulnerability Assessment Progress

Michael S. Scott, PhD, GISP
ESRGC/Salisbury University
March 31, 2009

## Meeting Agenda

- Discuss method steps
- Examine maps
- Examine GIS, if necessary
- Discuss particular areas that need extra attention as well as particular mitigation strategies
- Discuss public meeting agenda

## Method Steps

- Gather historical flood information
  - Completed
- Review available GIS data
- Conduct vulnerability assessment
- Conduct mitigation capability assessment
  - On-going, will be the subject of the next MCT meeting

## Review Available GIS Data

- Flood Elevations and Periodicity
  - FIRMs and Flood Insurance Studies
    - Calvert County, Unincorporated Areas (1986)
    - City of North Beach (1984)
    - Town of Chesapeake Beach (1984)
  - USACE SLOSH Model (draft) maps

## Review Available GIS Data

- Calvert Parcels/Building footprints
  - Used to refine property centroids
- Maryland PropertyView centroids
  - Building assessment information
- Critical infrastructure
  - Road network
  - Locations of schools, nursing homes, etc
- Orthophotography
- Topography
  - 10 ft DEM from LiDAR

## Conduct Hazard Assessment

- Rectify the most recent FIRMs
- Digitize the flood boundary
- Break the flood boundary polygons into their respective stream reaches
  - Hall Creek only
- Digitize the location of cross-sections and capture the 100-year flood height and discharge amounts
- Record adjusted coastal flood heights and assign to flood boundary polygons
- Denote the center of the floodway

## Conduct Hazard Assessment (cont.)

- Buffer the center to enclose the floodplain
- Clip the LiDAR data to the extent of each reach
- Run HAZUS Flood Information Tool (FIT)
  - Riverine
    - Provide the cross sections, the floodplain extent, and the LiDAR data
    - Calculates initial flood depths then asks for the definition of non-conveyance areas
  - Coastal
    - Provide coastline characterization, floodplain extent, LiDAR data, and stillwater elevations/wave setup
- Merge all of FIT results
- Result is the flood depth grid for the County

## Conduct Vulnerability Assessment

- Find the intersection with the flood boundary
  - Maryland PropertyView points selected in or near existing 100-year floodplain
  - Points moved to building locations
  - Critical infrastructure
- For each building centroid, we collected
  - Building use
    - SFR, MFR, Retail, Government, Industrial, etc
  - Foundation construction materials
  - Date of construction
  - Height of foundation (generalized)
  - Assessed value of the improvements

## FIS or SLOSH?

Flood Insurance Study

- Completed in either 1984 or 1988
- No way to examine the models used
- Consistently underestimates the height of the water during coastal flood events
  - Seen during Hurricane Isabel, a 65- to 70-year storm

- Sea, Lake and Overland Surges from Hurricanes
  - Developed by the National Hurricane Center
  - Calvert study conducted in 2006 by USACE
  - Seems to yield a more reasonable flood height

## Preliminary Results - FIS

- Preliminary work completed, comparing building locations within new 100-yr flood zone
  - 194 buildings impacted (86% are SFD)
  - $6,009,986 in potential damage
  - Further broken down by occupancy class

Cluster Locations

- Cove Point
- Solomon's Island
- Broome's Island
- North Beach
- Chesapeake Beach (south side)

## Preliminary Results - FIS

| Occupancy Class | Count | Predicted Building Loss ($) | Predicted Contents Loss ($) | Total Assessed Value ($) | % Building Loss |
|---|---|---|---|---|---|
| Retail Trade | 3 | [illegible] | [illegible] | [illegible] | [illegible] |
| Personal & Repair Services | 4 | [illegible] | [illegible] | [illegible] | [illegible] |
| Medical Offices | 1 | [illegible] | [illegible] | [illegible] | [illegible] |
| Entertainment & Recreation | 2 | [illegible] | [illegible] | [illegible] | [illegible] |
| College/Universities | 1 | [illegible] | [illegible] | [illegible] | [illegible] |
| General Government | 1 | [illegible] | [illegible] | [illegible] | [illegible] |
| Food/Drug/Chemical Industry | 2 | [illegible] | [illegible] | [illegible] | [illegible] |
| Single Family Dwelling | 184 | [illegible] | [illegible] | [illegible] | [illegible] |
| Mobile Homes | 2 | [illegible] | [illegible] | [illegible] | [illegible] |
| Multi-Family Residential | 2 | [illegible] | [illegible] | [illegible] | [illegible] |
| Hotel | 1 | [illegible] | [illegible] | [illegible] | [illegible] |
| Totals | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

## Critical Facilities – FIS

- No critical facility points are within the 100-year floodplain, but a few are within 100 meters
- WW Treatment Plants
  - Industrial Park WWTP on Skipjack Rd
  - Chesapeake Beach WWTP
- Fire Stations
  - North Beach Volunteer Fire Company
- Emergency shelters - None

## Critical Facilities – FIS (cont.)

- Schools
  - Our Lady Star of the Sea School
- Police
  - Hallowing Point Station – NRP
  - Solomons Police Substation
- Nursing homes - None
- Government buildings - None

## Preliminary Results - SLOSH

- Preliminary work completed, comparing building locations within new 100-yr flood zone
  - 467 buildings impacted (87 % are SFD)
  - $26 729 055 in potential building damage
  - Further broken down by occupancy class
- Cluster Locations
  - Cove Point
  - Solomon's Island
  - Broome's Island
  - North Beach
  - Chesapeake Beach

## Preliminary Results - SLOSH

| Occupancy Class | Count | Total Damage Building Loss ($) | Total Damage Contents Loss ($) | Total Damage Value ($) | % Building Loss |
|---|---|---|---|---|---|
| Water Trade | 8 | [illegible] | [illegible] | [illegible] | [illegible] |
| Personal & Repair Services | 7 | [illegible] | [illegible] | [illegible] | [illegible] |
| Medical Offices | 7 | [illegible] | [illegible] | [illegible] | [illegible] |
| Entertainment & Recreation | 3 | [illegible] | [illegible] | [illegible] | [illegible] |
| College/University | 3 | [illegible] | [illegible] | [illegible] | [illegible] |
| General Government | 2 | [illegible] | [illegible] | [illegible] | [illegible] |
| Food/Drug/Chemical Industry | 1 | [illegible] | [illegible] | [illegible] | [illegible] |
| Single Family Dwelling | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Mobile Home | 1 | [illegible] | [illegible] | [illegible] | [illegible] |
| Multi Family Residential | 13 | [illegible] | [illegible] | [illegible] | [illegible] |
| Hotel | 2 | [illegible] | [illegible] | [illegible] | [illegible] |
| Other | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

## Critical Facilities - SLOSH

- No change from FIS to SLOSH
- WW Treatment Plants
  - Industrial Park WWTP on Skipjack Rd
  - Chesapeake Beach WWTP
- Fire Stations
  - North Beach Volunteer Fire Company
- Emergency shelters – None
- Schools
  - Our Lady Star of the Sea School
- Police
  - Hallowing Point Station – NRP
  - Solomons Police Substation

## Next Steps

- Which numbers to use?
- A return to the field ..
- Areas of critical concern
  - Cove Point, Broome's Island, .
  - What others should specifically be mentioned?
- Are there areas where mitigation measures
  - Have been implemented in the past?
  - Are planned for the future?
- What sort of mitigation strategies are most achievable, given the fiscal, environmental, and political realities of Calvert County?

Calvert County
**FLOOD MITIGATION PLAN**

**Mitigation Core Team Meeting #3**
**23 April 2009**
1:30-3:30pm
**AGENDA**

PowerPoint Presentation – Working meeting

- Findings
- Goals and Objectives
- Preliminary Mitigation Actions

Discussion of 1st Public Meeting (30 April 2009)

Wrap-up and Next Steps

- Draft Plan
- Discuss Mitigation Core Team Meeting #4 (4 June 2009)
- Discuss Public Meeting #2 (18 June 2009)

Questions

Adjournment

23 April 2009
3rd Steering Committee Meeting

Presented by
Deepa Srinivasan, AICP, CFM
Vision Planning and Consulting, LLC

VISION

## Goals and Actions Categories

- Preventive Measures (codes, ordinances, regulations, procedures)
- Property Protection (relocation/acquisition, elevation, insurance)
- Emergency Services (hazard warning/response, critical facilities protection, post-disaster recovery, and mitigation)
- Structural Projects (bridges/culverts, channel modifications, dams)
- Natural Resource Protection (wetland protection, BMPs, open space)
- Public Information (map information, outreach, environmental educ.)

## Risk Assessment Findings

No critical facilities within 100-year floodplain, but a few within 100m

- Wastewater Treatment Plant
  - Industrial Park wastewater treatment plant on Skipjack Rd
  - Chesapeake Beach wastewater treatment plant
- Fire Stations
  - North Beach Volunteer Fire Company
- Schools
  - Our Lady Star of the Sea School
- Police Stations
  - Hallowing Point Station – NRF
  - Solomon's Police Substation

## Goals and Objectives

### Prevention

*Goal 1 Direct population concentrations away from known or predicted high flood hazard areas through appropriate regulations*

- Promote hazard mitigation goals through implementation of other existing plans and ordinances
- Examine language in ordinances to ensure that any new development in the County does not increase the vulnerability to flooding and make changes if required
- Continue to ensure that the current building codes, floodplain ordinances, wetland protection, and erosion and sediment control standards are properly enforced
- Consider rejoining CRS to continue to implement flood mitigation activities
- Consider a multi-objective management approach that promotes public involvement & coordination of floodplain management with other community concerns such as economic development, housing, water quality and recreation

## Risk Assessment Findings

Cluster Locations

- Cove Point
- Solomon's Island
- Broome's Island
- North Beach
- Chesapeake Beach
- Need to add other areas that were mentioned at the meeting

## Goals and Objectives

### Property Protection

*Goal 2 Ensure new construction and reconstruction is resistant to flood damage*

- Encourage high-risk, pre-FIRM residential structures to use retrofitting techniques to avoid repeated flooding
- Support projects and programs to retrofit, relocate/acquire structures that are susceptible to repetitive flooding
- Emphasize the importance of flood insurance to residents

## Goals and Objectives

### Emergency Services

*Goal 3: Improve coordination during emergencies*

- Improve coordination and notification procedures between departments within the County and municipalities that are responsible for implementing flood mitigation activities

*Goal 4: Ensure critical facilities are less vulnerable to flooding*

- Identify appropriate mitigation techniques for critical facilities in the floodplain
- Identify vulnerable public and private critical facilities and encourage pre-disaster retrofit

## Goals and Objectives

### Structural Projects

- *Goal 5: [illegible] to add goal*

## Goals and Objectives

### Natural Resource Protection

*Goal 6: Protect existing natural resources and open-space within the floodplain and watersheds*

- Ensure all acquired properties are cleared and remain in public owner-ship in perpetuity.
- Consider best management practices for development in the 100-year floodplain

## Goals and Objectives

### Public Information

*Goal 7: Increase flood-awareness among county residents*

- Involve community residents in the implementation of this Flood Mitigation Plan and in protecting their lives and property
- Promote the accuracy of the DFIRMS/FIRMS by requesting a restudy

## Preliminary Mitigation Actions

**Prevention**

- Based on sea level rise and wave action, adopt a 2-foot freeboard (currently 1 foot) above the BFE for the county and municipalities
- Review zoning density and restrict zoning to low density in 100-year floodplain (conservation, agricultural, or large lot residential use).
- Consolidate the floodplain ordinance into the County's Zoning Ordinance
- Consider rejoining the CRS program. Hire a consultant to complete the CRS application and develop a template for future use
- Require that recorded plats show hazardous areas.
- Improve accuracy of FIRMs/DFIRMs by requesting FEMA restudy. Incorporate DFIRM information into future flood mitigation planning efforts.
- The storm surge flood level model for Chesapeake Bay surge inundation for Calvert County was incorrect and off by 2 feet. What is the actual

## Preliminary Mitigation Actions

**Property Protection**

- Consider elevation or acquisition of repetitive loss properties in specific areas – Atlantic Avenue, North Beach, Poplar and Chesapeake Drive, Lusby, Means Drive and Bayside Road, Chesapeake Beach
- Consider a lower threshold for substantial improvements such as 40% so that more building projects meet the flood protection standards.
- Identify uninsured property owners in known flood hazard areas and encourage them to purchase flood insurance

## Preliminary Mitigation Actions

Emergency Services (from 2004 County All-hazard Mitigation Plan)

- Establish a partnership with NWS to enhance existing flood forecast & warning system – Advanced Hydrologic Prediction Service Program
- Prepare a power back up plan to county's critical facilities
- Increase number of NOAA weather radio public places across county
- Provide adequate shelters with back up power in all areas/parts of county to serve as safe place during floods and other hazards

## Preliminary Mitigation Actions

Structural Projects

- Develop permit procedures that require examination of the potential for flood damage to a road, bridge, culvert, water line or sewer line as well as regular maintenance
- Conduct a flood audit to identify ways to protect critical facilities

## Preliminary Mitigation Actions

Natural Resource Protection

- Consider transfer of development rights (allow developer to purchase development from property owners in special areas such as the high risk floodplain to let them remain open space forever, in return allow the developer to use the units that would have been allowed to increase units on non floodplain land)
- Implement BMPs during construction or as part of a project's design to permanently address nonpoint source pollutants. In addition to improving water quality, BMPs can have flood related benefits. By managing runoff, they can attenuate flows and reduce the peaks after a storm

## Preliminary Mitigation Actions

Public Information

- Prepare a presentation to demonstrate what happens when future adverse impacts caused by development are not accounted for, and the benefits of planning, higher mapping and regulatory standards
- Conduct environmental and safety education programs to teach children about flooding, forces of nature, significance of protecting watersheds and floodplains and educate the floodplain property owners and elected officials
- Develop a county newsletter to include information on hazards
- Make FIRMs and FIS available for public review

## Preliminary Mitigation Actions

Public Information (continued)

- Include floodplain management outreach activities on the Patuxent River Appreciation Day
- Develop a map website that allows users to determine their firm zone and other property information. Also consider adding links to gages to provide real-time water levels and national weather service flood crest predictions. Include additional data with aerial photographs and information on additional hazards, flooding outside mapped areas, and zoning and development regulations

## Repetitive Loss Properties - MDE

- Atlantic Avenue, North Beach - Abandon use of lowest floor. Install water equalizing vents to allow flooding without damage. Elevate all utilities above the Base Flood Elevation (medium priority).
- Poplar Drive, Lusby – Consider a comprehensive plan of the area for acquisition and demolition of structures. Sewer drainage fields do not function during periods of high water table. Elevate all utilities, including exterior HVAC unit, above the Base Flood Elevation (medium priority).
- Chesapeake Drive, Lusby – Consider a comprehensive plan of the area for acquisition and demolition of structures. Sewer drainage fields do not function during periods of high water table. Elevate all utilities, including exterior HVAC units, above the Base Flood Elevation. As another option, a floodwall/planter could be constructed around the perimeter of the structure (medium priority)

## Repetitive Loss Properties - MDE

- Mears Dame, Chesapeake Beach - Abandon use of lower floor. Install water equalizing vents to allow flooding without damage. Elevate all utilities to upper floor level (high priority)
- Bayside Road, Chesapeake Beach - Acquire and demolish structure. If this option is not feasible, install flood shields at all door openings and elevate all utilities above the Base Flood Elevation. Use appliances with electrical components on top (high priority).

## Next Steps

- 4th Core Team Meeting – 4 June 2009
  - Finalize Goals
  - Finalize Mitigation Actions
  - Prioritize Mitigation Actions
- Final Public Meeting – 18 June 2009
- Preparation of Draft Plan for review
- Submission of Draft Plan to MEMA

Calvert County
FLOOD MITIGATION PLAN

Steering Committee Meeting #4
3 June 2009
1 pm-3pm
AGENDA

Mitigation Actions

- Discussion and review of mitigation actions
- Comments by Steering Committee
- Identification of Responsible Agencies and Implementation Schedule

Prioritization of Actions

- Review of prioritization criteria

Wrap-up

- Next steps
- Discuss Public Meeting #2 (16 June 2009)
- Questions

Adjournment

# APPENDIX 2

## Public Meeting Materials

Public Meeting 1 Notice

The public is invited to a Public Forum on the development of an updated

## Calvert County Flood Mitigation Plan

**Date:** **Thursday, April 30, 2009**

**Time:** **7 p.m.**

**Location:** **Courthouse Square**, 205 Main Street, Prince Frederick, MD 20678 (Located at the corner of Duke St & Main St — Enter from the parking lot – lower level of building)

## IS FLOODING IN YOUR COMMUNITY A MAJOR CONCERN TO YOU?

The Calvert County Department of Planning & Zoning will host the first Public Forum on Thursday, April 30, 2009 to present the assessment of the flood risk in the County and solicit public input. All residents owning property in flood or other hazard-prone areas, or those who would be affected by potential regulatory changes are encouraged to attend.

The meeting will be held at the **Courthouse Square.** A second Public Forum will be held in June 2009. At the second meeting, the Draft Flood Mitigation Plan with mitigation actions will be presented.

As a result of a grant from the Maryland Emergency Management Agency, Calvert County formed a Mitigation Task Force comprising of county staff, municipal representatives, and residents to assist with the countywide Flood Mitigation Planning Process. The Task Force held its first meeting in November Since that time the advisory group has worked together to develop the Plan which aims to identify the flood hazard; assess the County's vulnerability to the hazards, and develop mitigation measures to help reduce the County's vulnerability and prevent loss of life, injury, and property damage.

**Lead organization for the Flood Mitigation Plan:**

Calvert County Department of Planning and Zoning

**Point of Contact:**

Steve Kullen, Watershed Planner — Phone: 410-535-1600 Extension 2336

Public Meeting 1 Sign-in Sheet

# April 30, 2009 Public Forum – Sign-In Sheet
## Calvert County Flood Mitigation Plan

| Name | Address | e-Mail |
|---|---|---|
| David A Pulignano | 1510 Lin Reed St. Lusby | dpart-pr@recanstar.T |
| Donald Barbara | Cof PO Box 208 SUNDERLAND MD 20689 | |
| [illegible] eBurns | 4803 Davenport St. NW Washington DC 20016 | JEBscout@aol.com |
| John KNOPP | DPW - Calvert Co | knoppjf@co.cal.md.us |
| Jeffrey Barnes | 10957 Cove Point Beach Lusby | jacbarnes@sunsys.edu |
| cl * Marjorie Little | 10972 Beach Dr - cove pt beach Lusby | [illegible] |
| Bill Gallagher | 3214 Calvert Blvd Lusby | bilgal@comcast.net |
| cl * Barbara Mason | 3204 Cove Point Beach Calvert Blvd, Lusby | barbarajmason@yahoo.com |
| Larry & Bonnie Ohler | PO Box 271, St Leonard | lohlertravel@yahoo.com |
| Marya B. Stoetzel | 1632 Bonheur Rd, St Leonard | maryastoetzel@yahoo.co |
| C Michael Rockius | 6500 Long Beach, St Leonard | rockius@chesapeake.net |
| Jay Snell | 11086 Cove Point Rd, Lusby | jamesinDC@comcast.net |
| Robert W. [illegible] | 6525 Long Beach Dr St Leonard | BW.11.e06@yahoo.com |
| Steve Kullen | 150 Main St. P.F | Kullensl@co.cal.md.us |
| Lori Kerrigan | 3137 Cove Point Beach Calvert Blvd Lusby | TKKerrigan@cuppernet |
| Frank Leland | 11014 Cove Point Beach BEACH DR, LUSBY | covepoint2@comcast.net |
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| Mason 3BR | | |
| 410. 326 4570 | | |
| 21 people - total | | |
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## Calvert County's Flood Mitigation Plan (Proposed): Planning Process and Hazard Assessment

Michael S Scott, PhD GISP
ESRGC/Salisbury University
April 30, 2009

## Meeting Agenda

- Why are we creating this plan?
- What are the goals of this plan?
- What is the process to create the plan?
- What areas of Calvert County are susceptible to flooding?
- Mitigation capability assessment

## Consulting Team

- Ms. Deepa Srinivasan, President
  - Vision Planning & Consulting, LLC
- Dr. Michael S Scott, Director
  - Eastern Shore Regional GIS Cooperative at Salisbury University

## Why are we creating this plan?

- In Calvert County, flooding is frequent occurrence has become part of the culture And yet Hurricane Isabel in 2003 and the riverine/tidal flooding in May 2006 shows that the County's residents continue to be vulnerable to floods
- Calvert County is bounded on the west by the Patuxent River, contains many rivers and streams (such as Hall Creek, Leonard Creek, and Mill Creek) It also has a large exposure to the Chesapeake Bay
- Calvert County is growing and developing (estimated 41% population increase from 2000 to 2030) likely increasing the exposure to the flood threat
- Plan Goal To reduce the vulnerability of Calvert County's residents and business owners to flooding
  - Riverine & Coastal
    - Floodplain
    - Storm surge
    - Tidal flooding

## What are the objectives of this plan?

- Be consistent with 44 CFR 78.5 – Flood Mitigation Plan Development in accordance with the National Flood Insurance Act
- Conform to all pertinent criteria, particular those found in state and local ordinances, as well as the NFIP
- Identify risks from flood
- Develop coherent mitigation strategies
- Help reduce the loss of life, personal injury and property damage to the County's residents and businesses
- Be approved by MEMA and FEMA, paving the way for future federal funding of mitigation projects

## What is the process to create the plan?

- Step 1 – Organize work group and process
- Step 2 – Assess hazards, risk, vulnerability, and mitigation capability
- Step 3 – Develop the mitigation plan
- Step 4 – Implement the plan

## Step 1 – Organize the work group and process

- Core Team has been established
  - Emergency Management Staff
  - Planning Staff
    - Environmental
    - Land Use
    - Code enforcement
  - Representatives from Towns
  - Impacted citizens
- 1st Core Team meeting was November 13th, 2008
  - Discussed were
    - Planning process
    - Key elements of the plan
    - Schedule
    - Deliverables
  - Mitigation capability assessment questionnaire was distributed

## Step 2 – Assess hazards, risk, vulnerability, and mitigation capability

- 2nd Core Team meeting was held March 31st, 2009
  - Preliminary hazard assessment was presented and comments incorporated
- 1st Public Meeting (tonight) will review the findings
- Definitions
  - Hazard – the threat to things we value
  - Risk – the probability the hazard might occur
  - Vulnerability – the potential for loss
  - Mitigation Capability – the degree of ability to either remove the threat or to resist and/or recover from a hazard event

## Step 3 – Develop the Mitigation Plan

- 3rd Core Team Meeting – April 23rd, 2009
  - Present the mitigation capability assessment
  - Development of specific plan goals and objectives
- Final Core Team Meeting – June 4th, 2009
  - Discussion of mitigation alternatives, prioritization of alternatives, and the implementation plan
- 2nd Public Meeting – June 18th, 2009
  - Present mitigation options and projects, the prioritization matrix, and the plan implementation schedule
  - Draft plans will be available

## Hazard and Vulnerability Assessment

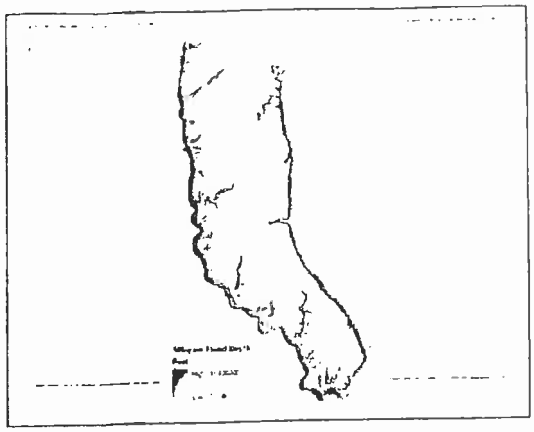
- Sought to determine for the 100-year event:
  - Where will it flood?
  - How deep will the floodwater likely be?
  - Which structures are likely to be impacted?
  - What is the value of those structures and their contents?
  - What is the likely damage to occur from a 100-year event?
- 100-year flood – has a 1% chance of happening every year

## Hazard and Vulnerability Assessment

- Determined using.
  - Flood insurance studies (range from 1984 – 1988)
  - Flood insurance rate maps (FIRMs)
  - USACE SLOSH Model (draft) maps
  - Most recent flood modeling software (HAZUS-MH) developed by FEMA
  - The best data available
    - USACE, MDNR, MDP, MDAT MDE, County Planning & Technology Services
  - A GIS-based spatial analysis
    - Digital mapping and analysis system

## Hazard and Vulnerability Assessment: Caveats

- Flood heights are out-of-date and (likely) incorrect
  - The Calvert County FIS states a 100-year storm surge as 5.8 ft above sea level at Dares Beach, for example.
  - Hurricane Isabel (a 60- to 70-year storm) generated a surge 6.4 feet in Dares Beach
  - USGS and USACE sources were used to create a more realistic flood height
    - Dares Beach height – 8.0 feet
- Reliable engineering studies of the County's flood threat have been sporadic and incomplete
  - Some are nearly 25 years old
  - HAZUS-MH cannot replace high-quality engineering studies



## What is the vulnerability of the County's built environment to a 100-year event?

- Total predicted properties damaged: 577
  - Total improved properties: 31,747 (1.82% damaged)
- Total predicted damage: $30,567,056
  - Structural building damage: $15,393,227
  - Building contents damage: $15,173,833
  - The total assessed value of structures & contents: $178,195,335
    - This damage is 17.2% of all value

## What is the vulnerability of the County's critical facilities to a 100-year event?

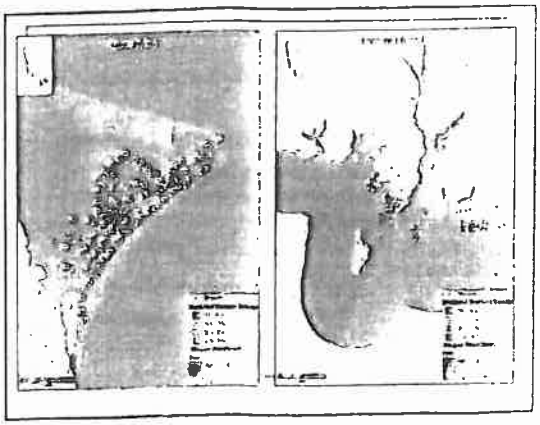
- No critical facility points are within the 100-year floodplain, but a few are within 100 meters
- WW Treatment Plants
  - Industrial Park WWTP on Skipjack Rd
  - Chesapeake Beach WWTP
- Fire Stations
  - North Beach Volunteer Fire Company
- Schools
  - Our Lady Star of the Sea School
- Police
  - Hallowing Point Station – NRP
  - Solomons Police Substation

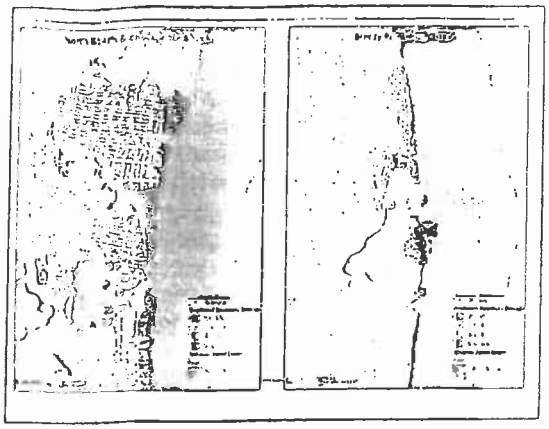
## What is the vulnerability of the County's built environment to a 100-year event?

- Other potential damage is not included
  - Public infrastructure (roads, bridges, culverts, dams),
  - Buildings other than primary building (garages, barns),
  - Losses due to evacuation, displacement, sheltering, crops, catch, etc

## What areas are susceptible to flooding in a 100-year event?

| Area | Vulnerable Structures |
|---|---|
| Cove Point | 166 |
| Broomes Island | 71 |
| Chesapeake Beach | 70 |
| North Beach | 61 |
| Plum Point | 45 |
| Long Beach | 32 |
| Breezy Point | 23 |
| Solomons | 18 |
| Lloyd Bowen Road | 17 |
| Johnstown/Dowell | 14 |
| Dares Beach | 8 |
| Olivet | 7 |
| Buzzard Island Creek | 6 |
| Owings | 4 |





## What is the degree of potential damage from a 100-year event?

| Degree of Damage | Property Count | % of Total | Value of Structure and Contents ($) | Total Potential Damage ($) | % of Total |
|---|---|---|---|---|---|
| Less than 5% | 26 | 5.2% | 10,277,710 | 209,711 | 0.6% |
| 5 – 10% | 71 | 12.3% | 46,068,200 | 3,653,062 | 12.0% |
| 10 – 15% | 132 | 22.9% | 30,586,250 | 3,542,644 | 11.6% |
| 15 – 20% | 98 | 17.0% | 27,288,535 | 6,268,611 | 20.5% |
| 20 – 25% | 68 | 11.8% | 12,895,085 | 2,808,794 | 9.5% |
| 25 – 30% | 67 | 11.6% | 20,276,040 | 5,612,077 | 18.0% |
| 30 – 40% | 75 | 13.0% | 13,849,555 | 4,587,702 | 14.9% |
| 40 – 50% | 7 | 1.2% | 2,241,360 | 1,004,414 | 3.3% |
| More than 50% | 72 | 4.0% | 4,715,100 | 2,615,836 | 8.6% |
| Total | 577 | | $176,195,335 | $30,567,056 | |

## How is the potential damage divided between property uses?

| Occupancy Class | Count | Predicted Building Loss ($) | Predicted Contents Loss ($) | Total Assessed Value ($) | % Loss |
|---|---|---|---|---|---|
| Commercial | 30 | 767,087 | 3,615,678 | 17,127,780 | 25.6% |
| Schools/Library | 1 | 28,535 | 334,896 | 713,500 | 36.6% |
| General Government | 2 | 30,009 | 192,183 | 669,180 | 32.3% |
| Industry | 6 | 382,237 | 2,221,614 | 26,624,850 | 10.2% |
| Church | 1 | 23,184 | 145,821 | 968,600 | 17.4% |
| Single Family Dwelling | 494 | 11,052,818 | 7,467,517 | 123,447,945 | 15.0% |
| Mobile Home | 10 | 797,268 | 297,729 | 2,407,865 | 45.5% |
| Multi-Family Dwelling | 30 | 1,136,258 | 903,442 | 9,215,635 | 22.8% |
| Total | 577 | 15,393,277 | 15,173,832 | 178,195,335 | 17.2% |

## What are County's current capabilities to mitigate losses from flooding?

- Complete set of ordinances, plans, and policies are currently being reviewed
- Information is currently being reviewed on:
  - Preventive Measures
  - Property Protection
  - Structural Projects
  - Natural Resource Protection
  - Public Information
  - Emergency Services
- Results will be presented to the public in June

## What to do now?

- Please review the maps
- Point out areas that you think flood often so that we can investigate them
- Ask lots of questions
- Stay involved
  - Public meeting with draft plan – an announcement will go out well ahead of time
  - Contact me with any thoughts or concerns (msscott@salisbury.edu)

# Musicians get big opportunity

Three young musicians from Huntingtown High School have gone on to perform with All-Eastern Honors Choir and All-Eastern Honors Orchestra, highly selective groups that draw students from across the Northeast.

Trumpet player Ian Dahlstrom was selected to join the orchestra, while tenor Joshua Olexa and alto Molly Wilkerson joined the All-Eastern Honors Mixed Choir.

Dan Boyer, Huntingtown's choir teacher, said it was an honor for students to be nominated for either group.

"Its more of an honor to get nominated," he said. "Each state nominates students who are capable of being selected and participate in the ensembles, and after that it's a statistical issue. They go through and it's a long, drawn-out process. In order to be selected you really had to be in the top echelon in terms of getting the selection. ... We were all very proud here at Huntingtown of their accomplishments.

## Join Marine Museum's lighthouse cruises

The Calvert Marine Museum is once again offering lighthouse lovers a chance to join the Lighthouse Adventure Cruises during the 2009 season.

All cruises are aboard a private charter vessel, and require advanced ticket purchase to secure a spot, according to a release.

The cruises are scheduled for Saturday, June 6, and Sept. 26. Both cruises will head south with departures from the Drum Point Lighthouse. Participants will visit Point No Point, Point Lookout and Smith Point Lighthouses before stopping for lunch at The Bayside Inn on Smith Island. After taking in the local sites, the cruise will continue on to circle Solomons Lump and Hooper Island Lighthouses.

On the journey, cruisers will learn the history of the lighthouses they visit from the museum's lighthouse expert, along with fascinating stories that make each light unique, from fires to ice floes to ravaging storms. Participants should bring sunscreen

WRITER'S NOTEBOOK

Erica Mitrano

a camera, hat and rain jacket.

The cost is $150 for the day-long trip; lunch is on your own. Register by May 15 and get the early bird special rate of $130. Museum members pay $125. Participants will meet at the Calvert Marine Museum under the Drum Point Lighthouse at 7:45 a.m.; expected return time to the museum is 4 p.m. Preregistration is required. For information or to register, call 410-326-2042, Ext. 41. Space is limited and sold on a first-come, first-serve basis.

## County hosting meeting on flood control

The Calvert County Department of Planning and Zoning will host the first public forum on Thursday, April 30, to present the assessment of the flood risk in the county and solicit public input, according to a release. All residents owning property in flood or other hazard-prone areas, or those who would be affected by potential regulatory changes, are encouraged to attend. The meeting will be held at the Courthouse Square.

The meeting will be held Thursday, April 30, at 7 p.m. at 205 Main Street in Prince Frederick. Enter the building from the parking lot at the lower level of the building.

A second public forum will be held in June. At the second meeting, the Draft Flood Mitigation Plan with mitigation actions will be presented.

Calvert and St. Mary's counties' League of Women Voters chapters.

The forum is titled "Nuclear Waste: Safety, Health and Environmental Issues," and will include a diverse panel of guests, according to a release. The forum panel will address issues and concerns including nuclear technologies, health, safety, environment and waste. The forum format includes a question and answer session from the audience.

Issues involving nuclear reactors are complex and difficult topics worthy of exploration to help raise the level of public understanding, according to a release. The league was encouraged to conduct such a forum by public demand in reference to the proposed third nuclear reactor at the Lusby plant, already the site of two other reactors in Lusby.

The forum will be held Wednesday, May 20, from 6:30 to 9 p.m. at Calvert Pines Senior Center, 450 W. Dares Beach Road in Prince Frederick.

## April 22 activities planned to recognize volunteers

April 22 is the day set aside for special recognition of Girl Scout leaders. The day is known in Girl Scouting as Leader Appreciation Day. Girls in the Washington, D.C.-area plan a variety of special activities and tributes to acknowledge the contributions of dedicated volunteers, without whom troops would not exist.

"Please, if you see a Girl Scout volunteer on April 22 or any other day, take the time to say 'thank you' [because] they are helping to build a better tomorrow for each of us by working with our girls today. Girl Scout Volunteers help to build girls of courage, confidence and character, who make the world a better place," according to the release.

Complete information on the Girl Scout Council of the Nation's Capital is available at www.gscnc.org, or by calling 800-523-7898 or 800-834-1702, Ext. 4020. To learn more about volunteering, e-mail ldavis@gscnc.org.

emitrano@somdnews.com

Public Meeting 2 Notice

You are invited to a Public Forum on the development of an updated

# Calvert County Flood Mitigation Plan

**Date:** Tuesday, June 16, 2009

**Time:** 7 p.m.

**Location:** Calvert Pines Senior Center - Auditorium, 450 West Dares Beach Road, Prince Frederick, MD 20678 Enter the main front entrance to the Auditorium.

## IS FLOODING IN YOUR COMMUNITY A MAJOR CONCERN TO YOU?

The Calvert County Department of Planning & Zoning will host the second Public Forum on Tuesday, June 16, 2009 to present the Draft Flood Mitigation Plan with mitigation actions. All residents owning property in flood or other hazard-prone areas, or those who would be affected by potential regulatory changes are encouraged to attend. The meeting will be held in the Calvert Pines Senior Center Auditorium at 7 p.m.

As a result of a grant from the Maryland Emergency Management Agency, Calvert County formed a Mitigation Task Force comprising of county staff, municipal representatives, and residents to assist with the countywide Flood Mitigation Planning Process. The Task Force held its first meeting in November. Since that time the advisory group has worked together to develop the Plan which aims to: identify the flood hazard; assess the County's vulnerability to the hazards; and develop mitigation measures to help reduce the County's vulnerability and prevent loss of life, injury, and property damage.

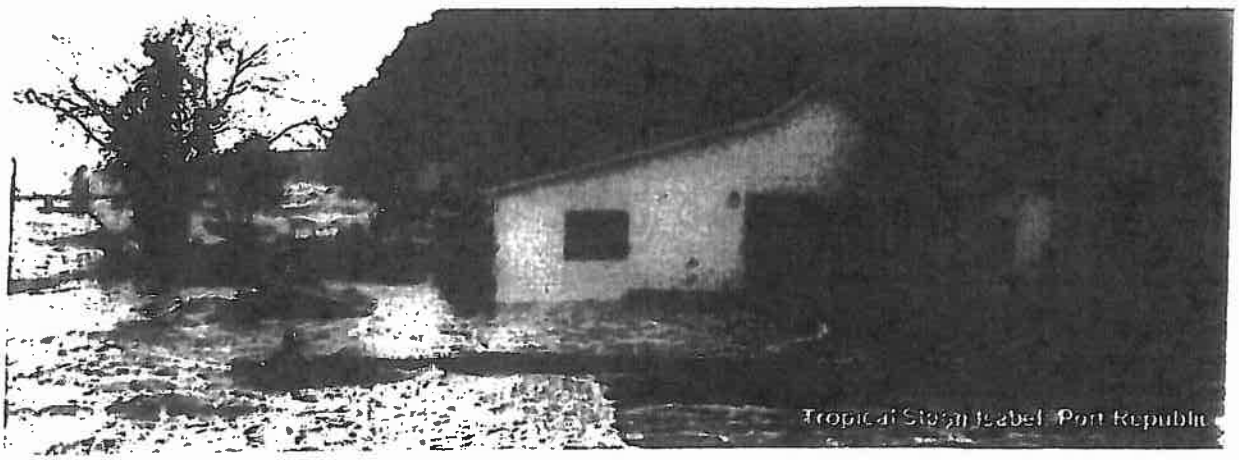
FEMA

**Lead organization for the Flood Mitigation Plan:**

Calvert County Department of Planning and Zoning

**Point of Contact:**

Steve Kullen, Watershed Planner – Phone: 410-535-1600 Extension 2336



Public Meeting 2 Sign-in Sheet

# FEMA Flood Mitigation Public Forum

Tuesday – June 16, 2009 7 p.m.
Calvert Pines Senior Center Auditorium

## Sign In Sheet

| NAME | ADDRESS | EMAIL INFO | PHONE |
|---|---|---|---|
| SANDRA BELL | 2991 GOVERNORS RUN RD | SANDRAJEANBELL | 443-295- |
| | PORT REPUBLIC MD 20676 | @COMCAST.NET | 7267 |
| CAROL BOOKER | 3149 CALVERT BLVD | CAROLBOOKER@YAHOO.COM | - |
| | LUSBY MD 20657 | | |
| KATHY DUNCAN | 3143 LIGHT HOUSE BLVD Lusby | KJDUNCAN58@YAHOO.COM. | |
| | | | |
| TOM KEARNEY | 3137 Calvert Blvd Lusby | TKKEARNEY@CUPPER.NET | 410 326-2470 |
| Frank Leland | 11014 Beach Drive, Lusby MD | covepoint2@comcast.net | 410 326 9131 |
| RITA ILG | 3245 WOODRIDGE AVE. Port Rep. | rita.ilg@LNF.com | 301-785-2550 |
| WILLIAM GALLAGHER | 3214 CALVERT BLVD, LUSBY MD 20657 | bilgal@comcast.net | 443-404-5886 |
| JOHN KNOPP | CALVERT CO GOV. | knoppjf@co.cal.md.us | 410-535-1600 |
| VALERIE STEWART | 3116 LIGHTHOUSE BLVD. LUSBY 20657 | valstewart@hotmail.com | 240 882 9402 |
| Barbara Mason | 3204 Calvert BLVD LUSBY 20657 | | 410-326-6570 |
| Marjorie tuttle | 10972 Beach Dr Lusby Md 20657 | artandsoul@verizon.net | 202-413-7996 |
| Brigid Quinn | 10985 Webster Dr. Lusby 20657 | brigidq@yahoo.com | 410/326-2416 |
| Rex Cox | 3164 Lighthouse Blvd 20657 | rex@cablespeed.com | 443-904-4130 |

# FEMA Flood Mitigation Public Forum

Tuesday – June 16, 2009 7 p.m.
Calvert Pines Senior Center Auditorium

## Sign In Sheet

| NAME | ADDRESS | EMAIL INFO | PHONE |
|---|---|---|---|
| Jay Fretz | one St. Rte. 11006 Elm Dr. Lusby, Md. | fomaine@dmcal.net | 410-326-3157 |
| LEA CALLAHAN | 3187 CALVERT BLVD LUSBY MD | EVCALLAHAN@usbcon | 410-326-8482 |
| Gwen Myers | 10951 Poplar Dr. Lusby, Md. | gwenmyers@verizon.com | 301-372-6211 |
| Michele Rockhill | 6500 Long Beach Dr St Leonard, MD | rockhill@chesapeake.net | 410 586 0658 |
| GEORGE + SANDY KAHL | 10971 BEACH DR LUSBY MD | georgekahl@comcast.net | 4103266479 |
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## Flood Mitigation Plan
## Calvert County, MD

VISION

LS GC

## Project Purpose

*To develop a flood mitigation plan to improve Calvert County's resistance to floods by identifying actions to reduce the impact of floods to county residents and structures*

## Key Players

- Calvert County Staff
- Flood Mitigation Plan Steering Committee
- Municipal Representatives
  - North Beach, Chesapeake Beach
- Consultants
  - Deepa Srinivasan, President, Vision Planning & Consulting
  - Dr. Mike Scott, Director, Eastern Shore Regional GIS Cooperative @ Salisbury University
- Public
- Maryland Emergency Management Agency (MEMA)
- Federal Emergency Management Agency (FEMA)

## Project Goals

- The Flood Mitigation Plan for Calvert County
  - Is consistent with the requirements of the 44 Code of Federal Regulations part 78.5 Flood Mitigation Plan Development;
  - Helps reduce the risk of loss of life, personal injury and property damage to the County's residences and businesses by identifying the flood risk;
  - Includes mitigation strategies to address the flood risk within the County, and
  - Will gain approval from the MEMA and FEMA, paving the way for future federal funding of flood mitigation projects

## Steps in the Planning Process

1. Organize steering committee and process (meetings)
2. Assess hazards, risks, vulnerability
3. Assess local capabilities
   - Existing Plans, Programs, Policies
   - Personnel and Equipment Resources
   - Local Codes and Zoning Ordinances
   - Current and Proposed Construction Projects

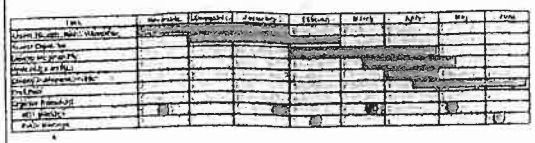
## Steps in the Planning Process cont'd

4. Develop goals and objectives and mitigation actions
   - Prevention
   - Property Protection
   - Public education and Awareness
   - Natural Resource Protection
   - Emergency Services
   - Structural Projects
5. Write mitigation plan and prioritize projects

## Steps in the Planning Process (cont'd)

- Develop implementation plan
  - Priorities for Mitigation Actions
    - Short-, Medium-, or Long-Range
    - Potential Funding Sources
    - Responsible Entities
    - Target Completion Dates
  - Five-Year Plan Maintenance Cycle

## Schedule



## Meetings

- 4 Steering Committee Meetings
  - Meeting 1 Planning process, schedule, deliverables, capability assessment
  - Meeting 2 Hazard identification, risk assessment
  - Meeting 3 Goals and objectives, Mitigation actions
  - Meeting 4 Mitigation actions prioritization and implementation
- 2 Public Meetings
  - Meeting 1
    - Planning process
    - Hazard identification, risk assessment, capability assessment
  - Meeting 2
    - Goals and objectives
    - Mitigation actions and implementation

## Capability Assessment

- Calvert County Plans
  - 2004 Comprehensive Plan Calvert County, 2004
  - 2004 County Hazard Mitigation Plan, 2004
  - Water Resources Update (update to Comp. Plan) October 2009
  - County Land Preservation, Parks and Recreation Plan, 2006
  - County Water and Sewage Plan, 2008

## Capability Assessment

- Calvert County Ordinances
  - County Floodplain Management Ordinance, 1992
  - Calvert County Zoning Ordinance, 2006 (rev June 2008)
    - Residential Development Requirements – Article 5
    - Subdivision Regulations - Article 7
    - Environmental Requirements – Article 8
    - Shore Erosion Protection Works – Article 9-B

## Sources of Flooding

- Riverine flooding sources:
  - Tributaries of the Patuxent River
  - Hall Creek
  - Hunting Creek
  - Battle Creek
  - Leonard Creek
  - Back River
  - Mill Creek
- Coastal flooding from the Chesapeake Bay

## Storm Surge Inundation

- Bluffs along the Chesapeake Bay offer protection to most shorelines on the eastern side of the county, though parts of Chesapeake Beach and North Beach are exposed to storm surge
- Low-lying areas adjacent to creeks and portions northwestern Calvert County along the Patuxent River also vulnerable

Source: 2014 Maryland State Hazard Analysis Chap 3:

## Critical Facilities in close proximity to Floodprone Areas

Critical facilities within 100 meters of the modeled floodzone

| Type | Name |
|---|---|
| WWTP | Industrial Park WWTP (Skipjack Road) |
| WWTP | Chesapeake Beach WWTP |
| Fire Station | North Beach Volunteer Fire Company |
| School | Our Lady, Star of the Sea School |
| Police Station | Hallowing Point Station (MDDNR) |
| Police Station | Solomons Police Substation |

## Structures within 100-year Floodplain

- Cove Point (166 structures)
- Broomes Island (71 structures)
- Chesapeake Beach (70 structures)
- North Beach (61 structures)
- Plum Point (45 structures)
- Long Beach (32 structures)
- Breezy Point (23 structures)

## Repetitive Loss Properties

- Lusby (Cove Point)– 15 properties
- Saint Leonard (Long Beach) – 6 properties
- Huntingtown (Plum Point) – 5 properties
- City of North Beach – 5 properties
- Town of Chesapeake Beach – 3 properties
- Broomes Island – 2 properties
- Owings – 2 property
- Solomons – 1 property

## Structural Damage by Building Type

1 Potential damage to structures/contents from a 100-year flood event by general occupancy type

| General Occupancy Type | Building Count | % of Total | Value of Structure and Contents | Total Damage | % of Total |
|---|---|---|---|---|---|
| Residential | 534 | 92.5 | 132,071,445 | 22,827,564 | 74.7 |
| Commercial | 30 | 5.2 | 17,127,780 | 4,362,715 | 14.3 |
| Educational | 1 | 0.2 | 713,500 | 261,431 | 0.9 |
| Government | 2 | 0.3 | 669,160 | 222,493 | 0.7 |
| Industry | 9 | 1.6 | 26,624,800 | 2,703,850 | 8.8 |
| Religious | 1 | 0.2 | 866,600 | 166,005 | 0.6 |
| Total | 577 | 100% | $178,195,285 | $30,567,058 | 100% |

Note: All dollar values are from 2007 tax assessments

# APPENDIX 3

## Mitigation Capability Questionnaire

# APPENDIX 3

**Mitigation Capability Questionnaire**

## FLOOD MITIGATION PLAN
## Calvert County, MD
## Flood Mitigation Capabilities Assessment Questionnaire

1. Critical Facilities Information

a. Have any critical facilities such as police and fire stations, hospitals, schools, etc. been damaged from past hazards? If so, please indicate the hazard event and describe the damage.

| Critical Facility | Address | Hazard Event | Damage Description |
|---|---|---|---|
| | | | |
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b Do any critical facilities fall within flood hazard areas? If so, please indicate the type of facility and location.

| Critical Facility | Location |
|---|---|
| | |
| | |
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2. Existing Plans and Ordinances

a. Does the City/County have the following plans? If so, indicate the document, year adopted, and the agency/department that administers it.

| Type of Plan | Name of Document | Year Adopted | Administered by |
|---|---|---|---|
| Comprehensive Plan | | | |
| Land Use Plan | | | |
| Zoning Ordinance | | | |
| Subdivision Ordinance | | | |
| Hazard Mitigation Plan | | | |
| Beachfront Management Plan | | | |
| Floodplain Development Ordinance | | | |
| Stormwater Management Plan | | | |
| Local Emergency Operations Plan | | | |
| Risk Assessment | | | |
| Capital Improvements Program | | | |

b. Do your plans and ordinances contain the following policies? If yes, please indicate the name of the plan or ordinance.

| Policy | Yes/No | Plan/Ordinance |
|---|---|---|
| Is there a freeboard requirement? If yes, how many feet? | | |
| Is there a policy preventing new development or substantial improvements to structures in floodplains? | | |
| Is there a regulation prohibiting fill in the floodplain? | | |
| Is there a regulation prohibiting enclosure of structural elements below BFE? | | |
| Is there a regulation requiring fill and building foundations be designed to protect them from scour, erosion? | | |
| Is there a requirement that critical facilities be protected from higher flood levels? | | |
| Is there a policy encouraging cluster development near floodplains, wetlands? | | |
| Is there a policy for prohibition against dumping or placing debris in stream channels? | | |
| Is there a regulation requiring erosion and sedimentation control during construction projects to reduce siltation and loss of channel carrying capacity? | | |
| Is there a requirement for new structures in the floodplain to submit 1st floor elevations? | | |



*Please fax your questionnaire to Deepa Srinivasan at 480 393 5396 by 4 December 2008*
*Thank you for your cooperation!*

3. **Flood Mitigation Projects**

a. Has the City/County completed any flood mitigation projects in the past? If so, please indicate the type of project, location, and year of completion.

| Flood Mitigation Projects | Yes/No | Location | Year Completed |
|---|---|---|---|
| **Property Protection** | | | |
| Buy outs | | | |
| Elevation of structures | | | |
| Floodproofing | | | |
| Berms/floodwalls | | | |
| **Structural Projects** | | | |
| Levees | | | |
| Drainage facilities | | | |
| Retention/detention basins | | | |
| **Emergency Services** | | | |
| Hazard warning (sirens, reverse 911) | | | |
| Hazard response (EOC activation, evacuation orders) | | | |
| Post disaster recovery (clearing streets, debris removal) | | | |
| Critical Facilities Protection (power stations, water/sewer facilities, police, fire, EMS, hospitals) | | | |
| **Natural Resource** Projects | | | |
| Wetlands protection | | | |
| Erosion and sedimentation control | | | |
| **Public Outreach** | | | |
| Map information | | | |
| Library resources | | | |
| Outreach projects (newsletters, brochures) | | | |
| Environmental education programs | | | |
| Real estate disclosure | | | |

4. **Staff Capabilities and Building Data**

a Please provide information on the City's/County's staff capabilities and buildings in the floodplain with respect to the following:

| Staff | Yes/No | Department |
|---|---|---|
| Floodplain Administrator | | |
| Building Official/Inspector | | |
| Site Plan Reviewer | | |
| Surveyor | | |
| GIS Specialist | | |
| Total buildings in floodplain | | |
| Total flood insurance policies | | |
| Total repetitive loss structures | | |

5. **Training**

a. Has your staff had any training in the following?

| Training | Yes/No | Staff Position |
|---|---|---|
| GIS | | |
| Floodplain management/NFIP regulations | | |
| Community Rating System | | |
| Building inspection | | |
| Building code administration | | |
| Building retrofits | | |
| | | |
| | | |

***Please include your information:*** *Name*_____ *Title* _____
*Phone number* *Email address*



*Please fax your questionnaire to Deepa Srinivasan at 480 393 5396 by 4 December 2008*
*Thank you for your cooperation!*

# APPENDIX 4

## Glossary

| Glossary | |
|---|---|
| Base Flood | The flood having a one-percent chance of being equaled or exceeded in any given year; the base flood also is referred to as the 1-percent annual chance (100-year) flood. |
| Base Flood Elevation (BFE) | The water surface elevation of the base flood in relation to the datum specified on the community's Flood Insurance Rate Map. In areas of shallow flooding, the base flood elevation is the highest adjacent natural grade elevation plus the depth number specified in feet on the Flood Insurance Rate Map, or at least four (4) feet if the depth number is not specified. |
| Community, Relative to Floodplain Management | A political subdivision of the State of Maryland (county, city or town) that has authority to adopt and enforce floodplain management regulations within its jurisdictional boundaries. |
| Critical and Essential Facilities | Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes. [Note: See Maryland Building Performance Standards, Sec. 1602 and Table 1604.5.] Critical and essential facilities typically include hospitals, fire stations, police stations, storage of critical records, facilities that handle or store hazardous materials, and similar facilities. |
| Federal Emergency Management Agency (FEMA) | The Federal agency with the overall responsibility for administering the National Flood Insurance Program. |
| Flood or Flooding | A general and temporary condition of partial or complete inundation of normally dry land areas from:<br>(1) The overflow of inland or tidal waters, and/or<br>(2) The unusual and rapid accumulation or runoff of surface waters from any source. |
| Flood Damage-Resistant Materials | Any construction material that is capable of withstanding direct and prolonged contact with floodwaters without sustaining any damage that requires more than cosmetic repair. [Note: See NFIP Technical Bulletin #2, "Flood Damage-Resistant Materials Requirements."] |
| Flood Insurance Rate Map (FIRM) | An official map on which the Federal Emergency Management Agency has delineated special flood hazard areas to indicate the magnitude and nature of flood hazards, to designate applicable flood zones, and to delineate floodways, if applicable. FIRMs that have been prepared in digital format or converted to digital format are referred to as Digital FIRMs (DFIRM). |

| | |
|---|---|
| **Flood Insurance Study (FIS)** | **The official report in which the Federal Emergency Management Agency has provided flood profiles, floodway information, and the water surface elevations.** |
| **Flood Protection Elevation:** | **The base flood elevation plus two (2) feet of freeboard, except for Solomons Town Center where the Flood Protection Elevation is 10' NAVD 88. Freeboard is a factor of safety that compensates for uncertainty in factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, obstructed bridge openings, debris and ice jams, climate change, and the hydrologic effect of urbanization in a watershed.** |
| **Flood Zone** | **A designation for areas that are shown on Flood Insurance Rate Maps:**<br>(1) **Zone A: Special flood hazard areas subject to inundation by the 1-percent annual chance (100-year) flood; base flood elevations are not determined.**<br>(2) **Zone AE and Zone A1-30: Special flood hazard areas subject to inundation by the 1-percent annual chance (100-year) flood; base flood elevations are determined; floodways may or may not be determined. In areas subject to tidal flooding, the Limit of Moderate Wave Action may or may not be delineated.**<br>(3) **Zone AH and Zone AO: Areas of shallow flooding, with flood depths of 1 to 3 feet (usually areas of ponding or sheet flow on sloping terrain), with or without BFEs or designated flood depths.**<br>(4) **Zone B and Zone X (shaded): Areas subject to inundation by the 0.2-percent annual chance (500-year) flood; areas subject to the 1-percent annual chance (100-year) flood with average depths of less than 1 foot or with contributing drainage area less than 1 square mile; and areas protected from the base flood by levees.**<br>(5) **Zone C and Zone X (unshaded): Areas outside of Zones designated A, AE, A1-30, AO, VE, V1-30, B, and X (shaded).**<br>(6) **Zone VE and Zone V1-30: Special flood hazard areas subject to inundation by the 1-percent annual chance (100-year) flood and subject to high velocity wave action (also see coastal high hazard area).** |
| **Floodplain** | **Any land area susceptible to being inundated by water from any source (see definition of "Flood" or "Flooding").** |

| | |
|---|---|
| Floodproofing or Floodproofed | Any combination of structural and nonstructural additions, changes, or adjustments to buildings or structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents, such that the buildings or structures are watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. [Note: State regulations at COMAR 26.17.11(B)(7) do not allow new nonresidential buildings in nontidal waters of the State to be floodproofed.] |
| Floodway | The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to pass the base flood discharge such that the cumulative increase in the water surface elevation of the base flood discharge is no more than a designated height. When shown on a FIRM, the floodway is referred to as the "designated floodway." |
| Lowest Floor | The lowest floor of the lowest enclosed area (including basement) of a building or structure; the floor of an enclosure below the lowest floor is not the lowest floor provided the enclosure is constructed in accordance with these regulations. The lowest floor of a manufactured home is the bottom of the lowest horizontal supporting member (longitudinal chassis frame beam). |
| Market Value | The price at which a property will change hands between a willing buyer and a willing seller, neither party being under compulsion to buy or sell and both having reasonable knowledge of relevant facts. For the purposes of these regulations, the market value of a building is determined by a licensed real estate appraiser or the most recent, full phased-in assessment value of the building (improvement) determined by the Maryland Department of Assessments and Taxation. |
| Maryland Department of the Environment (MDE) | A principal department of the State of Maryland that is charged with, among other responsibilities, the coordination of the National Flood Insurance Program in Maryland (NFIP State Coordinator) and the administration of regulatory programs for development and construction that occur within the waters of the State, including nontidal wetlands, nontidal waters and floodplains, and State and private tidal wetlands (Tidal Wetlands). Unless otherwise specified, "MDE" refers to the Department's Wetlands and Waterways Program. |
| Maryland Emergency Management Agency (MEMA) | MEMA and MDE are the responsible agency for administering the flood management programs in Maryland. |
| National Flood Insurance Program (NFIP) | The program authorized by the U.S. Congress in 42 U.S.C. §§4001 - 4128. The NFIP makes flood insurance coverage available in communities that agree to adopt and enforce minimum regulatory requirements for development in areas prone to flooding (see definition of "Special Flood Hazard Area"). |

| | |
|---|---|
| Special Flood Hazard Area (SFHA) | The land in the floodplain subject to a one-percent or greater chance of flooding in any given year. Special flood hazard areas are designated by the Federal Emergency Management Agency in Flood Insurance Studies and on Flood Insurance Rate Maps as Zones A, AE, AH, AO, A1-30, and A99, and Zones VE and V1-30. The term includes areas shown on other flood maps that are specifically listed or otherwise described in Section 1.5. |
| Substantial Damage | Damage of any origin sustained by a building or structure whereby the cost of restoring the building or structure to its before damaged condition would equal or exceed 50 percent of the market value of the building or structure before the damage occurred. Also used as "substantially damaged" structures. |
| Substantial Improvement | Any reconstruction, rehabilitation, addition, or other improvement of a building or structure, the cost of which equals or exceeds 50 percent of the market value of the building or structure before the start of construction of the improvement. The term includes structures which have incurred substantial damage, regardless of the actual repair work performed. The term does not, however, include either:<br>(1) Any project for improvement of a building or structure to correct existing violations of State or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official prior to submission of an application for a permit and which are the minimum necessary to assure safe living conditions; or<br>(2) Any alteration of a historic structure, provided that the alteration will not preclude the structure's continued designation as a historic structure. |

# APPENDIX 5

## Resolution of Adoption

**ORDINANCE NO. _____**

Pertaining to the Adoption of the Calvert County Flood Mitigation Plan

**WHEREAS,** pursuant to the authority contained in Article 66B of the Annotated Code of Maryland, the Board of County Commissioners of Calvert County, Maryland, has general powers to promulgate and adopt County plans; and

**WHEREAS,** after study and evaluation, the Department of Planning and Zoning recommended to the Planning Commission and the Board of County Commissioners of Calvert County, Maryland, a draft Calvert County Flood Mitigation Plan; and

**WHEREAS,** after due notice was published, the Planning Commission conducted a public hearing on July 20, 2011, at which time the proposed plan was discussed, staff's recommendations were considered, and public comment was solicited; and

**WHEREAS**, at the conclusion of said public hearing, the Planning Commission voted to recommend to the Board of County Commissioners of Calvert County, Maryland, adoption of the plan as proposed; and

**WHEREAS,** after due notice was published, the Board of County Commissioners of Calvert County, Maryland, conducted a public hearing on July 26, 2011, at which time the proposed plan was discussed, staff's recommendations were considered, and public comment was solicited; and

**WHEREAS**, at the conclusion of said public hearing the Board of County Commissioners of Calvert County, Maryland, voted to adopt the Flood Mitigation Plan with minor amendments as indicated in Exhibits A, attached hereto and made a part hereof; and

**WHEREAS**, after considering the evidence that was presented at the public hearings regarding the proposed plan and the recommendation of the Planning Commission, the Board of County Commissioners of Calvert County, Maryland, adopted the Calvert County Flood Mitigation Plan as amended.

**NOW, THEREFORE, BE IT RESOLVED AND ORDAINED,** by the Board of County Commissioners of Calvert County, Maryland, that the Calvert County Flood Mitigation Plan **BE,** and hereby **IS,** adopted as shown in attached Exhibit A, and effective on the date set forth below.

**DONE**, this _____ day of _____, 2011, by the Board of County Commissioners for Calvert County, Maryland, sitting in regular session.

ATTEST:

_____
Corinne J. Cook, Clerk

Approved for legal
sufficiency on _____
by

_____
Pamela R. Lucas,
Associate County Attorney

BOARD OF COUNTY COMMISSIONERS
CALVERT COUNTY, MARYLAND

_____
Susan Shaw, President

_____
Pat Nutter, Vice President

_____
Gerald W. Clark

_____
Evan K. Slaughenhoupt Jr.

_____
Steven R. Weems