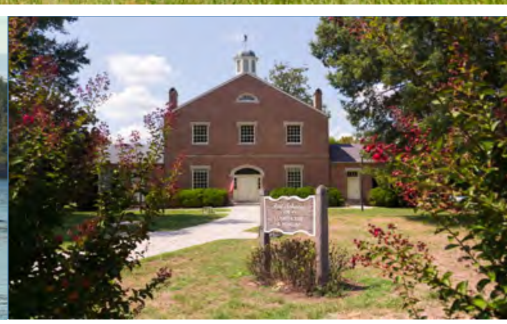
Charles County
2018 Hazard Mitigation Plan Update

September 2018

Charles County
Government

200 Baltimore Street
La Plata, MD 20646


This plan was developed through the Charles County Hazard Mitigation Committee that included representatives from the following Departments and Lateral Partners:

Charles County Department of Emergency Services

Charles County Sheriff's Office

Charles County Department of Planning and Growth Management

Charles County Department of Public Works

Charles County Department of Parks, Recreation, and Tourism

Charles County Soil Conservation District

Charles County Volunteer Fire Department

Charles County Department of Health

Town of Indian Head

Town of Port Tobacco Village

Town of La Plata

College of Southern Maryland

Port Tobacco River Conservancy

Maryland State Highway Administration

Maryland Historical Trust

Maryland Emergency Management Agency

Maryland Farm Service Agency

TABLE OF CONTENTS

List of Figures

LIST OF TABLES

CERTIFICATION OF ANNUAL REVIEW MEETINGS

The Charles County Mitigation Planning Committee has reviewed this Multi-Jurisdictional Hazard Mitigation Plan. See Chapter 7 of this Plan for further details regarding the following table. The Director of the Charles County Emergency Services hereby certifies this review.

Year	Date of Meeting	Public Outreach Addressed?	Signature
2019			
2020			
2021			
2022			
2023			

EXECUTIVE SUMMARY

The County of Charles has been and will continue to be committed to a long-term strategy for reducing the risks of hazards.

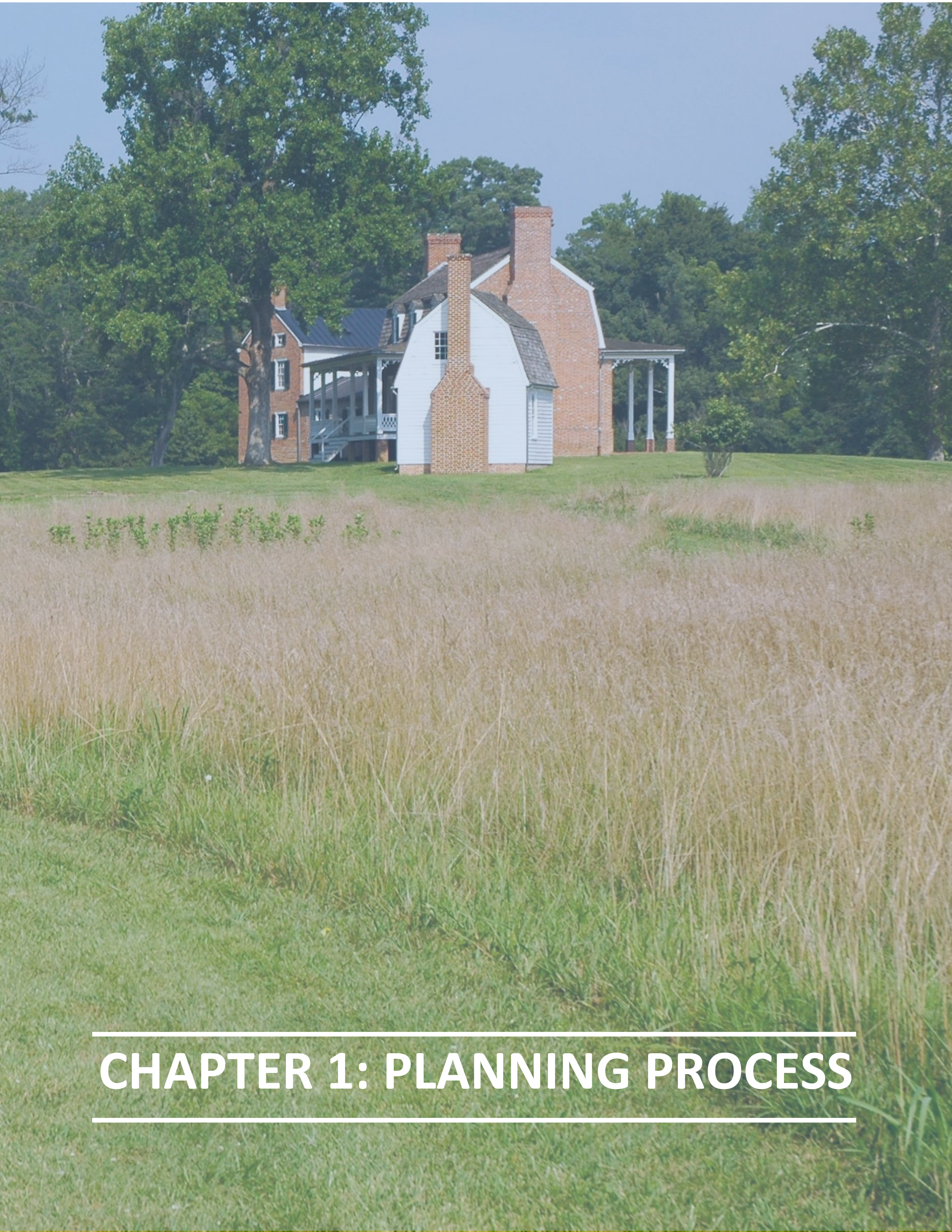
The intention of this Hazard Mitigation Plan (HMP) update is to serve as a blueprint for coordinating and implementing hazard mitigation policies, programs, and projects. It provides a list of mitigation goals, objectives, and related actions that may assist Charles County in reducing risk and preventing loss from future natural hazard events. The impacts of hazards can be lessened and sometimes avoided altogether if appropriate actions are taken before hazardous events occur. By avoiding unnecessary exposure to known hazard risks, communities will save lives and preserve property and minimize the social, economic, and environmental disruptions that commonly follow hazard events. Charles County and its jurisdictions agree that hazard mitigation makes sense. Through the identification of vulnerable areas and the implementation of measures aimed at minimizing exposure, the negative impacts of natural hazards may be reduced for Charles County.

Some portions of Charles County were developed long before natural hazards were fully understood. Therefore, some sections of our community are vulnerable to flooding, tornadoes and high wind, severe storms and lightning, wildfire, and other hazards. Working through the cycle of hazard mitigation can help ensure that vulnerabilities will not increase. Encouraging acquisition, relocation, or retrofitting of existing vulnerable structures, along with the protection of valuable natural resources, can minimize damages and help make sure that our community is built back better and stronger than before.

Communities face significant challenges during post-disaster redevelopment in balancing the driving need for rapid recovery with implementing long-term hazard mitigation. The necessity to meet basic needs and resettle displaced populations immediately following a disaster often overshadows the more abstract, longer-term sustainability considerations. Once full-scale reconstruction is initiated, it is difficult to modify projects in progress to meet sustainability objectives. This trend highlights the need for pre-disaster mitigation planning that incorporates principles of sustainable development within the context of reconstruction, so that communities can more easily rebuild in a manner that will make them less vulnerable to future hazard events while improving the quality of life.

It is imperative that local decision makers become and stay involved in this planning process to provide new ideas and insight for future updates to the HMP for Charles County. Now that a mitigation strategy has been developed (2006) and updated (2012 and again in 2018),) it will remain a challenge and a goal for Charles County to provide necessary updates as mitigation techniques are implemented. It remains imperative that all local agencies, units of government, non-profit organizations, businesses and industries, and private citizens continue their involvement and dedication to hazard mitigation.

It is our long-term goal that the Hazard Mitigation Plan and the strategies identified will be fully integrated into daily decisions and routines of government and business. This will continue to require dedication and hard work, and this Plan update will continue to lay the building blocks in order to further strengthen the sustainability and resiliency of Charles County.



CHAPTER 1: PLANNING PROCESS

1 Planning Process

This section of the Hazard Mitigation Plan (HMP) describes the mitigation planning process undertaken by Charles County, the Charles County Hazard Mitigation Planning Committee (HMPC), and participating municipalities in the preparation of this HMP Update. This chapter consists of the following subsections:

- Background
- Purpose
- Scope
- Authority and Reference
- Overview of Hazard Mitigation Planning
- Local Methodology and Update Process
- The Planning Team
- Planning Meetings and Documentation
- Public and Stakeholder Participation
- Multi-Jurisdictional Planning and Participation

1.1 Background

Across the United States, natural and human-caused disasters have led to increasing levels of death, injury, property damage, and interruption of business and government services. The time, money, and effort needed to recover from these disaster events exhausts resources and diverts attention from important public programs and private agendas. Since 1962, there have been 32 Presidential Disaster Declarations and Emergency Declarations in Maryland, 21 of which have affected Charles County (FEMA, 2018). The emergency management community, citizens, elected officials, and other stakeholders in Charles County recognize the impacts disasters can have on their communities and support proactive efforts needed to reduce the potential effects of natural and human-caused hazards.

Presidential Disaster and Emergency Declarations

Maryland: 32

Charles County: 21*

**A full list of these declarations is provided in Section 3.2*

Emergency management is the discipline of identifying, managing, and avoiding risks. It seeks to promote safer, more resilient communities and involves:

- Planning and preparing for a disaster before it occurs
- Supporting those affected by the disaster
- Rebuilding after the natural or human-made disaster event
- Taking actions to reduce or minimize long-term risk

Emergency management is a dynamic process in which individuals, groups, and communities attempt to manage hazards to avoid or reduce the potential impacts of disasters.

There are four phases of emergency management:

- **Preparedness:** Planning, preparations, and other activities undertaken to facilitate response operations as well as save lives and property. Preparedness activities take place before an emergency occurs.
- **Response:** Actions that provide emergency assistance, save lives, minimize property damage, and speed recovery. Response takes place during and immediately after a disaster event.
- **Recovery:** Actions taken to return to a normal or improved condition following an emergency or disaster event. Recovery occurs after a disaster.
- **Mitigation:** Any sustained action to reduce or eliminate long-term risk to life and property resulting from natural and human-made hazards and their impacts. Mitigation occurs before and after a hazard event, and creates successive benefits over time.

Figure 1.1-1: Phases of Emergency Management (FEMA, 2017)

Hazard Mitigation: *Any sustained action to reduce or eliminate long-term risk to life and property resulting from natural and human-made hazards and their impacts.*

Pre-disaster mitigation actions are taken in advance of a hazard event and are essential to breaking the disaster cycle of damage, reconstruction, and repeated damage. A core assumption of hazard mitigation is that pre-disaster investments will significantly reduce the demand for post-disaster assistance by lessening the need for emergency response, repair, recovery and reconstruction. Furthermore, mitigation measures enable local residents, businesses, and industries to reestablish themselves in the wake of a disaster, which helps get the community economy back on track sooner and with fewer interruptions. With careful selection, successful mitigation actions are cost-effective means of reducing risk of loss over the long-term.

Hazard mitigation planning is a process of identifying policies, capabilities, activities, and tools necessary to implement successful and sustainable mitigation actions. Why undertake mitigation planning? Mitigation planning offers many benefits, including:

- Saving lives and preserving property
- Reducing insurance costs
- Promoting quick and effective recovery following disasters
- Reducing future vulnerability through wise development and post-disaster recovery and reconstruction
- Enhancing coordination within and across participating jurisdictions
- Expediting the receipt of pre-disaster and post-disaster grant funding
- Demonstrating a firm commitment to improving community health and safety

The benefits of mitigation planning go beyond reducing hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, improving water quality, maintaining environmental health, and enhancing recreational opportunities. Thus, it is vitally important that any local mitigation planning process be integrated with other concurrent local planning efforts, and any proposed mitigation strategies must consider other existing community goals or initiatives that will help complement or hinder their future implementation. Charles County and its participating jurisdictions have embraced this approach of identifying multiple opportunities to link the HMP with preexisting programs, policies, plans and initiatives. More information on this topic can be found in Chapter 5: Capability Assessment.

During the last two decades, the approach to the emergency management cycle has evolved considerably. A renewed emphasis has been placed on planning for disasters before they occur as a complement to effective response and recovery. As a result, hazard mitigation has gained increasing prominence as a critical part of emergency management. By taking sustained action to reduce or eliminate long-term risk to human life and property from hazards, risks can be proactively mitigated in a systematic manner, rather than reacted to after they occur.

> *"By taking **sustained action** to **reduce** or **eliminate long-term risk** to **human life** and **property** from hazards, risks can be **proactively mitigated** in a systematic manner, rather than reacted to after they occur."*

This 2018 HMP Update is the result of continuing work by the citizens of Charles County to update the pre-disaster multi-hazard mitigation plan that will not only continue to guide the County towards greater disaster resistance, but will also respect the character, needs, and capabilities of the community.

1.2 Purpose

Charles County developed its previous HMPs in 2006 and 2012, which provided momentum for making homes, businesses, and communities as safe as possible against the impacts of floods, tornadoes, wildfires, and other natural hazards. The initial HMP assessed the effectiveness of prior and current programs and activities in the community and identified shortfalls. Mitigation measures were further developed to help reduce Charles County's risk and exposure to these natural hazards. The 2012 HMP built upon this effort, assessing additional hazards, risks, and capabilities to develop an even stronger and more comprehensive mitigation strategy.

Charles County remains dedicated in continuing the work started in 2006 and is updating the HMP in 2018 in order to:

- Provide a blueprint to protect life and property from the impacts of a future disaster by reducing the potential for future damages and economic losses
- Qualify the County for additional grant funding, in both pre-disaster and post-disaster environments
- Improve community resiliency and provide quick recovery and redevelopment following future disasters

- Demonstrate a firm local commitment to hazard mitigation principles
- Comply with state and federal legislative requirements tied to local hazard mitigation planning

1.3 Scope

This HMP Update has been prepared to meet requirements set forth by the Federal Emergency Management Agency (FEMA) and the Maryland Emergency Management Agency (MEMA) in order for Charles County to maintain eligibility for funding and technical assistance from state and federal hazard mitigation programs. The HMP will continue to be updated and maintained to continually address natural and human-made hazards determined to be of high and moderate risk as defined by the updated results of the local Hazard Identification and Risk Assessment. Other natural and human-made hazards will continue to be evaluated during future updates to the HMP in order to determine if they warrant additional attention, including the development of specific mitigation measures intended to reduce their impact. This HMP will be updated and FEMA approved within a five-year cycle. Updates may also take place following significant disasters, and the HMP will be subject to reviews and potential updates on an annual basis.

1.4 Authority and Reference

This HMP will be adopted by Charles County in accordance with the authority granted to counties by the State of Maryland.

This HMP was updated in accordance with current state and federal rules and regulations governing local hazard mitigation plans. Authority for this plan originates from the following federal sources:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C., Section 322, as amended;
- Code of Federal Regulations (CFR), Title 44, Parts 201 and 206;
- Disaster Mitigation Act of 2000, Public Law 106-390, as amended; and
- National Flood Insurance Act of 1968, as amended, 42 U.S.C. 4001 et seq.

*The **Robert T. Stafford Disaster Relief and Emergency Assistance Act** is the statutory authority for most Federal disaster response activities.*

*The **Disaster Mitigation Act of 2000** established mitigation planning requirements as a condition of mitigation grant assistance.*

The HMP shall be monitored and updated on a routine basis to maintain compliance with the legislation and guidance above, as well as the following state rules and regulations:

- Maryland Emergency Management Agency (MEMA), established in the Maryland Code. The Emergency Management Policy was updated in 1991 through Executive Order 01.01.1991.02 State of Maryland Emergency Management Policy.

The following Federal Emergency Management Agency (FEMA) guides and reference documents were used to prepare this document:

- FEMA. 386-1: Getting Started: Building Support for Mitigation Planning. September 2002.
- FEMA. 386-2: Understanding Your Risks: Identifying Hazards and Estimating Losses. August 2001.
- FEMA. 386-3: Developing the Mitigation Plan: Identifying Mitigation Actions and Implementation Strategies. April 2003.
- FEMA. 386-4: Bringing the Plan to Life: Implementing the Hazard Mitigation Plan. August 2003.
- FEMA. 386-5: Using Benefit-Cost Review in Mitigation Planning. May 2007.
- FEMA. 386-6: Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning. May 2005.
- FEMA. 386-7: Integrating Manmade Hazards into Mitigation Planning. September 2003.
- FEMA. 386-8: Multi-Municipality Mitigation Planning. August 2006.
- FEMA. 386-9: Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects. August 2008.
- FEMA. Local Mitigation Planning Handbook. March 2013.
- FEMA. Local Mitigation Plan Review Guide. October 2011.
- FEMA. National Fire Incident Reporting System 5.0: Complete Reference Guide. January 2008.
- FEMA. Hazard Mitigation Assistance Unified Guidance. September 2013.
- FEMA. Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards. January 2013.
- FEMA. Plan Integration: Linking Local Planning Efforts. July 2015.

The following MEMA reference document was also used to prepare this document:

- State of Maryland 2016 Hazard Mitigation Plan. August 2016.

The following additional guidance document produced by the National Fire Protection Association (NFPA) was used to update this plan:

- NFPA 1600: Standard on Disaster/Emergency Management and Business Continuity Programs. 2007.

1.5 Overview of Hazard Mitigation Planning

Local hazard mitigation planning is the process of organizing community resources, identifying and assessing hazard risks, and determining how to best minimize or manage those risks. This process results in a HMP that identifies specific mitigation actions, each designed to achieve short-term planning objectives and realize a long-term community vision. To ensure the functionality of each mitigation action, responsibility is assigned to a specific individual, department, or agency along with a schedule for its implementation. Plan maintenance procedures are established to implement, as well as evaluate and enhance the HMP as necessary. Developing clear plan maintenance procedures ensures that Charles County's HMP remains a current, dynamic, and effective planning document over time.

1.6 Local Methodology and Update Process

This HMP contains a narrative description of the process followed to prepare the plan. All municipalities were notified in October 2017 of the mitigation planning requirement, the HMPC, and 2018 HMP Update planning process. Additionally, other county departments, state, and regional organizations were invited to HMPC meetings. The HMP Update process was conducted over the course of eight months, from October 2017 to April 2018. Throughout the planning update process, the Charles County HMPC reviewed and analyzed each section of the plan. In preparing the updated HMP, documentation indicates that the HMPC utilized a multi-jurisdictional planning process consistent with the one recommended by FEMA (Publication Series 386).

The first Charles County HMP was adopted in November of 2006. In mid-2003, the Charles County HMPC started preparing the HMP to fulfill the requirements of the Disaster Mitigation Act of 2000. Development of the update was a concerted effort on the part of Charles County and the Towns of La Plata and Indian Head. The 2006 Plan addressed 15 natural hazards and one human-made hazard. Each of those hazards were evaluated based on past occurrences, vulnerability of county and municipal assets, and potential loss estimates. In addition, the 2006 HMP identified hazards that were considered to have the highest probability of occurrence. An update to the 2006 HMP was initiated in July of 2011 with funding support from MEMA and FEMA. The 2012 HMP examined a total of 13 hazards, including 10 natural hazards, and 3 human-made hazards. Several hazards profiled in 2006 were combined for the 2012 HMP; for example, Extreme Summer Heat and Extreme Winter Cold were assessed as a single hazard (Temperatures Extremes) rather than profiled separately. Additionally, two new human-made hazards were profiled in 2012, including Public Health Emergencies and Nuclear Incidents.

The planning process used for the 2018 HMP Update was based on Section 322 of the Disaster Mitigation Act of 2000 and supporting guidance developed by FEMA. The planning process followed these steps:

- Conduct an Internal Pre-Kickoff Meeting with Charles County Emergency Management staff and Michael Baker International staff
- Conduct a Kick-Off Meeting with the HMPC
- Establish a Cultural and Historical Resources Sub-Committee
- Conduct a Risk Assessment Meeting with the HMPC
- Review and update the Hazard Identification and Risk Assessment
- Conduct a Mitigation Solutions Meeting with the HMPC
- Update the Capability Assessment to assess existing capabilities and mechanisms for the County and each municipality to carry out the Mitigation Strategy
- Update the Mitigation Strategy
- Update the Plan Maintenance procedures
- Complete a draft plan for review by Charles County
- Conduct a Draft Plan Review Meeting with a presentation to the Charles County Commissioners
- Advertise 30-day public comment period for public to review and comment on draft plan
- Provide final draft to MEMA for review

- Provide final draft to FEMA for review
- Present HMP to Charles County for adoption
- Present HMP to municipalities for adoption

In accordance with the Disaster Mitigation Act of 2000, the Charles County 2018 HMP Update details the following topics:

- Planning Process
- Hazard Identification and Risk Assessment
- Mitigation Strategy (Goals, Objectives, and Actions)
- Plan Review, Evaluation, and Implementation
- Plan Adoption

Each of the planning steps described above resulted in key products and outcomes that collectively make up the Charles County HMP. These work elements are further discussed below for introductory purposes.

Chapter 2 - Community Profile: This chapter describes the general makeup of Charles County and its municipalities, including prevalent geographic, demographic, economic, and development characteristics. This baseline information provides a snapshot of the Countywide planning area and thereby assists participating officials in recognizing those social, environmental, and economic factors that ultimately play a role in determining community vulnerability to natural and human-made hazards.

Charles County 2018 HMP Outline

1. Planning Process
2. Community Profile
3. Hazard Identification and Risk Assessment
4. Historic and Cultural Resources Vulnerability Assessment
5. Capability Assessment
6. Mitigation Strategy
7. Plan Execution and Maintenance
8. Conclusion

Chapter 3 – Hazard Identification and Risk Assessment: This chapter contains a summary of the hazard identification and update process, individual hazard profiles for eight natural hazards and nine human-made hazards, and a vulnerability assessment. Together, these elements serve to identify, analyze, and assess Charles County's overall risk. This chapter builds on available historical data from previous occurrences, updates information and analysis contained in the hazard-by-hazard profiles, and culminates in a hazard risk priority or ranking based on conclusions about the frequency of occurrence, potential impact, spatial extent, warning time, and duration of each hazard. FEMA's Hazus loss estimation methodology was also used in evaluating known flood risks according to their relative long-term cost, measured in expected damages. The Hazard Identification and Risk Assessment is designed to assist communities in seeking the most appropriate mitigation actions to pursue and implement by focusing their efforts on those hazards of greatest concern and those structures or planning areas facing the greatest risks.

Chapter 4 – Historic and Cultural Resources Vulnerability Assessment: This chapter focuses on assessing the vulnerability of the County's historic and cultural resources to natural and human-made hazard events. This includes an assessment of the risk and vulnerability of historic and cultural sites, districts, and other resources throughout Charles County. This assessment also identifies high priority sites and areas for mitigation activity, identifies areas for further study, and includes recommendations that are incorporated in the Mitigation Strategy in Chapter 6.

Chapter 5 – Capability Assessment: This chapter includes an evaluation of the County and its jurisdictions regarding their planning, regulatory, administration, technical, financial, educational, and outreach capabilities. This includes an assessment of governmental structure, political framework, legal jurisdiction, fiscal status, policies and programs, regulations and ordinances, and resource availability. These factors are evaluated with respect to their strengths and weaknesses in preparing for, responding to, and mitigating the effects of the profiled hazards. This exercise plays a key role in the hazard mitigation planning process by helping to determine the feasibility and relative appropriateness of various hazard mitigation action items that may be identified as part of the hazard mitigation strategy. This chapter also contains a section focused on plan integration, which assesses ways that Charles County currently integrates hazard mitigation with other community planning initiatives and examines additional opportunities for further integration. Combined with the risk assessment, the capability assessment informs the update of a meaningful and feasible Mitigation Strategy.

Chapter 6 – Mitigation Strategy: This chapter consists of broad goal statements as well as specific mitigation actions for each jurisdiction participating in the planning process. This updated strategy provides the foundation for the detailed Mitigation Action Plan that links jurisdictionally specific mitigation actions to locally assigned implementation mechanisms and target completion dates. Together, these sections are designed to make the HMP more strategic and functional through the identification of both long-term goals and near-term actions that will guide day-to-day decision-making and project implementation.

In addition to the identification and prioritization of possible mitigation projects, emphasis is placed on the use of program and policy alternatives to help make Charles County and participating municipalities less vulnerable to the damaging forces of nature while improving the economic, social, and environmental health of the community. The concept of multi-objective planning is emphasized throughout this HMP Update, identifying ways to link hazard mitigation policies and programs with complementary community goals that may be related to housing, economic development, community revitalization, recreational opportunities, transportation improvements, environmental quality, land development, and public health and safety. This HMP Update should be a proactive document that represents a concerted effort to make Charles County and participating jurisdictions more livable communities.

Chapter 7 – Plan Execution and Maintenance: This chapter includes the measures Charles County and participating jurisdictions will take to ensure the HMP’s continuous long-term implementation. The procedures also include the way the HMP will be regularly monitored, reported upon, evaluated, and updated to remain a current and meaningful planning document.

Chapter 8 – Conclusion: This section of the HMP provides a summary of the 2018 HMP Update, emphasizes its overall goals and purpose, and outlines next steps.

The HMPC reviewed the current plan, identified additional information that needed to be included in the HMP Update and incorporated it as required by state and federal guidelines. The HMPC was also tasked with collecting all accurate data from plan participants and provided outreach to the public and business stakeholders to ensure that everyone's information is included in this HMP Update.

1.7 The Planning Team

A well-rounded community-based planning team contributed heavily to the development of this HMP Update. The Charles County Department of Emergency Services spearheaded the update process, with the support of the HMPC. Charles County engaged past HMPC members, county and local government officials, state agencies, stakeholders, and the public in local meetings and planning workshops to discuss and complete tasks associated with preparing the HMP Update.

The participants listed in Table 1.7-1 represent the members of the HMPC who were responsible for participating in the updating of this HMP.

Table 1.7-1: **2018 HMPC Members**

NAME	ORGANIZATION
Michelle Lilly	Charles County Department of Emergency Services
Jennifer Adams	Charles County Department of Emergency Services
Chris Thompson	Charles County Department of Emergency Services
Beth Groth	Charles County Department of Planning and Growth Management
Hamendra Mathur	Charles County Department of Planning and Growth Management
Esther Read	Charles County Department of Planning and Growth Management
Cathy Thompson	Charles County Department of Planning and Growth Management
Steve Staples	Charles County Department of Public Works
Elsa Ault	Charles County Engineering and Floodplain Permits
Brian Hayden	Charles County Parks, Recreation, and Tourism
Bill Smith	Charles County Volunteer Fire Department
Jason Stoddard	Charles County Sheriff's Office
Richard Boggs	Charles County Sheriff's Office
Luis Dieguez	Charles County Soil Conservation District
Donna Thomas	Charles County Department of Health
Karen Lindquist-Williams	Town of Indian Head
Michelle Miner	Town of La Plata
Anita Gordon	Port Tobacco Village
Julie Simpson	Port Tobacco River Conservancy
Bill Bessette	College of Southern Maryland
Randy Jouben	College of Southern Maryland
Kelly McGuire	Maryland Emergency Management Agency
Jen Sparenberg	Maryland Historical Trust

Table 1.7-1: 2018 HMPC Members	
NAME	**ORGANIZATION**
Patrick Goode	Maryland Farm Service Agency
Ashley Farmer	Maryland State Highway Administration
Sarah Bowen	Michael Baker International
Matthew Bodnar	Michael Baker International
Mark James	Michael Baker International
Laura Johnson	Training Outreach

1.8 Planning Meetings and Documentation

Below is a summary of the key meetings and workshops conducted by the Charles County HMPC during the plan update process. Invitations, agendas, sign-in sheets, and minutes for these meetings are included in Appendix C.

1.8.1 Internal Kick-Off Meeting

The Internal Kick-Off Meeting held on October 4, 2017 served as a project coordination meeting with representatives from Charles County and Michael Baker International. The intent of this meeting was to discuss the planning process, project schedule, dates for upcoming meetings, and data needs and requirements.

Charles County 2018 HMP Update Timeline

October 4, 2017: Internal Kick-Off Meeting
November 8, 2017: Kick-Off Meeting
November 29, 2017: Risk Assessment Meeting
December 13, 2017: Mitigation Solutions Meeting
March – April 2018: Public Comment Period
May 2018: Submission to MEMA/FEMA
May-June 2018: HMP Adoption

1.8.2 Kick-Off Meeting

The Kick-Off Meeting was held on November 8, 2017 at the College of Southern Maryland in La Plata. The intent of this meeting was to provide an overview of the project, discuss the 2018 mitigation planning process and requirements, and review the 2012 HMP. The HMPC reviewed hazards profiled in the 2012 HMP, discussed new hazards to include in the 2018 HMP, and completed a risk evaluation and identification exercise. An overview of the capability assessment and mitigation strategy components of the HMP was also provided, and HMPC members completed a capability assessment survey. This data provided officials with a more thorough understanding of the hazard risks in their communities, along with the varied levels

Figure 1.8-1: Kick-Off Meeting

of local capabilities available to address them. The group also conducted a five-year review of the 2012 HMP, during which committee members discussed changes in risk since 2012, challenges to implementing mitigation projects, and strengths and weaknesses of the existing HMP. The Cultural and Historic Resources Sub-Committee also met following this meeting to discuss expectations and data needs for this element of the plan.

1.8.3 Risk Assessment Meeting

The Risk Assessment Meeting was held on November 29, 2017 at the College of Southern Maryland in La Plata. The purpose of this meeting was to review hazards in detail, discuss changing risks since the 2012 HMP Update, and identify hazards to profile in the 2018 HMP Update. This discussion identified that the following hazards had experienced an increase in risk since 2012: tornado, thunderstorm and lightning, public health emergency, and flood. The HMPC also discussed that there has been an increase in risk for all hazards to some extent because of more extreme weather events and changing future conditions. It was also determined that several new hazards should be included in the 2018 HMP Update. Based on discussions and analysis conducted prior to the meeting, the HMPC also discussed ranking and prioritizing hazards for mitigation action. A risk identification mapping exercise was also conducted at this meeting to supplement data provided by the County and other state and federal sources. The Cultural and Historic Resources Sub-Committee also met following this meeting to discuss risks related to historic properties and gaps in available data.

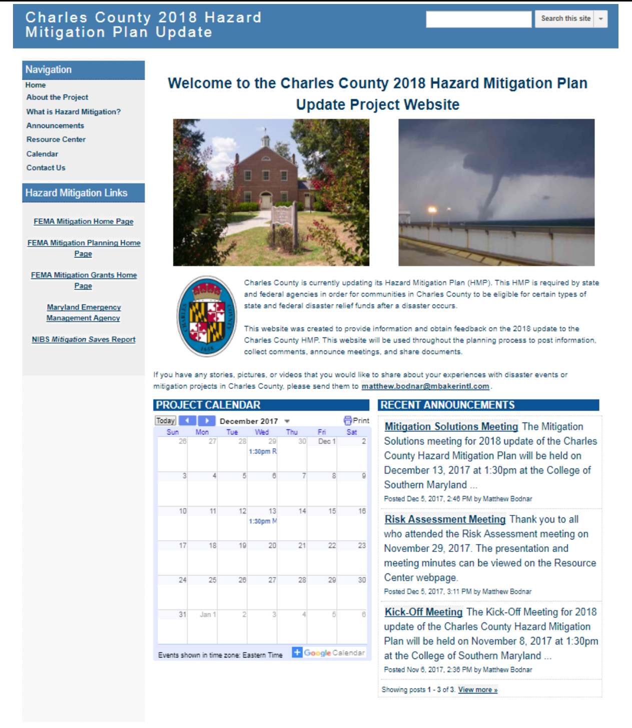
1.8.4 Mitigation Solutions Meeting

The Mitigation Solutions Meeting was held on December 13, 2017 at the College of Southern Maryland in La Plata. A major portion of the meeting focused on discussing mitigation goals, types of mitigation actions, and mitigation projects to include in the 2018 HMP. Goals from the 2012 HMP were reviewed, and additional goals were identified, such as to preserve cultural and historic resources through hazard mitigation. The HMPC also discussed how these goals aligned with the 2016 Maryland State HMP. Several exercises were conducted during and after the meeting, including a Mitigation Action Progress Report, a New Action Identification Form, and a Risk Factor Evaluation. The Cultural and Historic Resources Sub-Committee also met following this meeting to discuss risks related to historic properties and appropriate mitigation techniques for historic and cultural resources. A representative from the Maryland Historical Trust attended this meeting to provide insight and guidance with preparing this section of the HMP.

1.9 Public and Stakeholder Participation

A vital component of Charles County's community-based mitigation planning process involves public, stakeholder, and jurisdiction participation. Individual citizen involvement provides the HMPC with a greater understanding of local concerns and ensures a higher degree of mitigation success by developing community "buy-in" from those directly affected by the planning decisions of public officials.

Figure 1.9-1: Meeting announcements posted on the Charles County HMP Update project website



Public input was sought using the following methods: (1) advertised open public meetings; (2) the posting of all development materials and a draft of the Charles County Hazard Mitigation Plan 2018 Update on a dedicated website that can be accessed from the Charles County website at www.charlescountymd.gov/es/em/emergency-management or directly by navigating to www.charlescountymdhmpu.com. The draft HMP Update was also available for review and comment at the Charles County Department of Emergency Services during the 30-day comment period and prior to adoption.

Each municipality was given multiple opportunities to participate in the HMP Update process through invitations to meetings, review of risk assessment results and mitigation actions, and an opportunity to comment on the draft of the HMP. The tools listed below were distributed at meetings or in meeting follow-up emails to solicit data, information, and comments from all municipalities in Charles County as well as other HMPC members and stakeholders. These resources were also posted to the project website.

- **Evaluation of Identified Hazards and Risk Worksheet:** Allows communities to provide information on the status of hazards in their community and nominate new hazards for inclusion in the 2018 HMP Update.
- **Capability Assessment Survey:** Collects information on local planning, regulatory, administrative, technical, fiscal, political, and resiliency capabilities to inform the countywide mitigation strategy.
- **Jurisdictional Risk Factor Evaluation Worksheet:** Allows communities to provide information on the perceived risk of hazards in their municipality compared to the ranked hazards for the County. Communities list whether the jurisdictional risk is greater, equal to, or less than the overall County's risk.

- **New Mitigation Action Worksheet:** Allows communities to propose mitigation actions for the HMP and include information about each action such as a lead agency/department, implementation schedule, priority, estimated cost, and potential funding source(s).
- **Mitigation Action Progress Report Form:** Allows communities that submitted hazard mitigation projects for the 2012 HMP to re-evaluate them to determine if they are still viable or if they have been completed or discontinued.

In addition to the County and its jurisdictions, representatives from the Port Tobacco River Conservancy, College of Southern Maryland, Strawberry Hills Civic Association, and various state agencies participated in the planning process.

1.10 Multi-Jurisdictional Planning and Participation

This HMP was developed using a multi-jurisdictional approach. Though county departments have resources such as technical expertise and data which local jurisdictions may lack; involvement from local municipalities is critical to the collection of local knowledge related to hazard events. Local municipalities also have the legal authority to enforce compliance with land use planning and development issues. The 2018 Charles County HMP includes the participation of County officials and the following municipalities:

- Town of Indian Head
- Town of La Plata
- Town of Port Tobacco Village

To satisfy multi-jurisdictional participation requirements, each of the local jurisdictions was asked to perform the following tasks:

1. Designate a representative to serve on the Charles County HMPC
2. Actively participate in the HMP Update process
3. Provide best available data as required to update to the local hazard, risk, and vulnerability assessment
4. Determine capability and provide copies of any planning, mitigation, or hazard-related documents for review and incorporation into the HMP
5. Support the updating of the current countywide mitigation strategy, including the update, evaluation, design, and adoption of general goal statements for all jurisdictions to pursue
6. Review and provide timely comments on all draft components of the HMP Update
7. Adopt the 2018 Charles County HMP Update, including the local mitigation action plan specific to their jurisdiction

Through the completion of these tasks, the Towns of Indian Head, La Plata, and Port Tobacco Village participated with Charles County in the updating of this Plan. Further, through the preparation of their own local mitigation action plans, these communities were responsible for addressing their most significant hazard concerns. This component of the HMP provides the opportunity for the jurisdictions to monitor and update their own specific HMP implementation responsibilities without necessarily having to meet with the HMPC. It also enables the jurisdiction to be solely responsible and accountable for those actions that apply to their jurisdictions.

Table 1.10-1: Multi-Jurisdictional Participation

JURISDICTION	COUNTY HMP MEETINGS			WORKSHEETS AND EXERCISES					
	KICK-OFF	RISK ASSESSMENT	MITIGATION SOLUTIONS	Evaluation of Identified Hazards & Risks Worksheet	Capability Assessment Survey	Jurisdictional Risk Factor Evaluation Worksheet	New Mitigation Action Worksheet	Mitigation Action Progress Report Form	Comment on Draft Plan
Charles County	X	X	X	X	X			X	X
Town of Indian Head		X							
Town of La Plata	X	X		X	X	X		X	
Town of Port Tobacco Village									X

All jurisdictions participated in the Plan update by either attending meetings, completing forms, or providing timely comments on draft components of the HMP. Because of scheduling conflicts and availability, the Town of Port Tobacco Village was unable to attend the HMPC meetings. However, the community provided comments and feedback on the draft HMP. Additionally, while none of the jurisdictions completed the new mitigation action worksheet, new actions were developed at meetings and submitted through email.

1.11 Data Sources

Throughout the HMP Update Process, existing plans, studies, reports, and technical information was reviewed and incorporated when applicable. Key data incorporated into the 2018 HMP Update included updated GIS data from Maryland's Mapping and GIS Data Portal (MD iMap), current parcel and critical facilities GIS data from Charles County, updated population and demographic information from the U.S. Census Bureau, the effective Flood Insurance Rate Map (FIRM) database (effective 5/4/2015) and Flood Risk Database from FEMA, historic hazard event data from the National Oceanic and Atmospheric Administration's Storm Events Database, historic property GIS data from Maryland Historical Trust and the National Park Service, and more. Additionally, the State of Maryland 2016 Hazard Mitigation Plan as well as Charles County's Comprehensive Plan, Emergency Operations Plan, Flood Risk Report, and Flood Insurance Study were reviewed and referenced throughout the planning process. Plans, studies and data specific to La Plata, Indian Head, and Port Tobacco were also reviewed and incorporated when applicable. A full list of reference material used during the planning process can be found in Appendix B – Bibliography.

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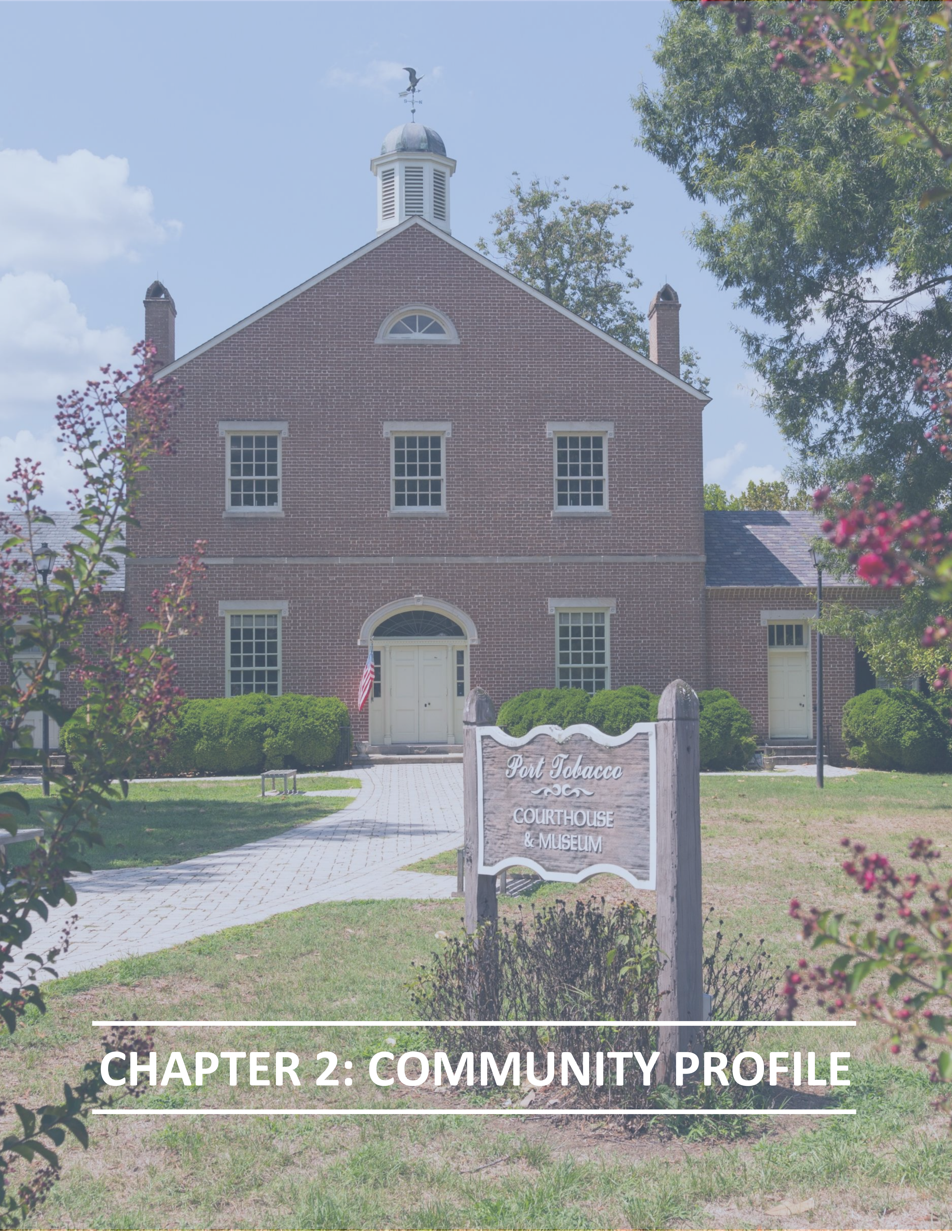


CHAPTER 2: COMMUNITY PROFILE

2 COMMUNITY PROFILE

The purpose of the Community Profile is to describe the characteristics of Charles County and its jurisdictions in order to better understand the context for the hazards assessed in this HMP, local community capabilities, vulnerable assets, and the mitigation strategy. Community characteristics highlighted in this section include basic information about Charles County's history, geography, population, demographics, economy, and development patterns. The Community Profile is divided into the following subsections:

- Geography and Environment
- Population and Demographics
- Jurisdictional Profiles
- Land Use and Development Trends

Charles County was founded in 1658 and named after Charles Calvert, early Governor of the colony of Maryland. The County is located in Southern Maryland, and surrounded by Prince George's County, Calvert County, St. Mary's County, and the Potomac River. Charles County forms a portion of the Washington Metropolitan Area, also known as the National Capital Region.

Charles County Facts

Founded: 1658
Total Area: 643 square miles
Land Area: 458 square miles
Population (2016): 154,357
Population Change (2010-2016): 5.3%
Households: 58,014
County Seat: Town of La Plata
Largest Community: Town of La Plata
Watersheds (HUC8): Lower Potomac, Patuxent, Middle Potomac-Anacostia-Occoquan

Sources: U.S. Census Bureau 2010, and 2016; USGS, 2013

The county is comprised of the Towns of La Plata, Indian Head, and Port Tobacco, and encompasses roughly 643 square miles. Additional areas with high population concentrations within Charles County include the communities of Bel Alton, Benedict, Bryans Road, Bryantown, Charlotte Hall, Cobb Island, Dentsville, Faulkner, Hughesville, Ironsides, Issue, Marbury, Marshall Hall, Mount Victoria, Nanjemoy, Newburg, Pisgah, Pomfret, Rison, Rock Point, St. Charles, Swan Point, Waldorf, Welcome, and White Plains.

The County is particularly known for its fervent cultural and historical heritage, the beautiful shorelines of the Potomac and Wicomico River, and its rural aesthetic. The landscape of Charles County is made up of compact rural settlements, spread across a vast region of farmland, streams, shorelines, and an extensive amount of undisturbed natural ecosystems.

The business base in Charles County presents a desirable location for industry and commerce. Consisting of eight industrial parks, with no inventory or manufacturing equipment tax. The economy contains a high amount of retail trade communications, utilities services, and local and federal government agencies. The

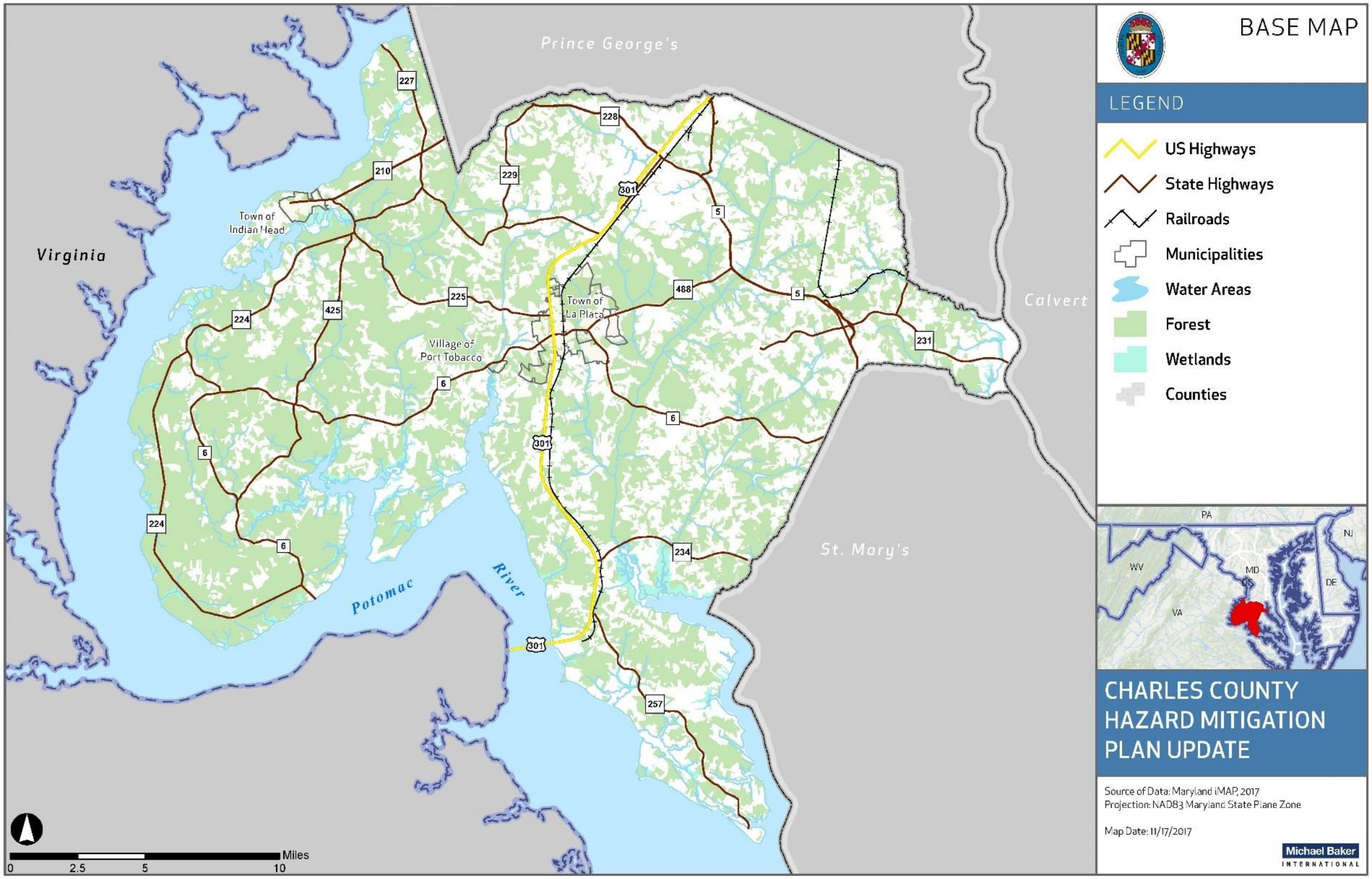
Naval Surface Warfare Center, College of Southern Maryland, Charles County Board of Education, Southern Maryland Oil Company, University of Maryland, and Charles Regional Medical Center are among the largest employers in the region.

2.1 Geography and Environment

While the total area of Charles County consists of 643 square miles, 458 of which are land, while the remaining 185 square miles consists of water. As shown in Figure 2.1-1, the three jurisdictions incorporated in Charles County include the Towns of La Plata, Indian Head, and Port Tobacco. The Town of La Plata is comprised of roughly 7.5 square miles, while the Town of Indian Head is made up of 1.23 square miles. The Village of Port Tobacco has the smallest land area, occupying only 0.16 square miles. The natural landscape of Charles County produces some of its most precious environmental assets. These include a vast shoreline, broad estuaries, heavily forested areas, scenic views of the Potomac and Wicomico Rivers, and rural terrain. Charles County's features create a setting of distinguished beauty that attracts many people, which accompanies population growth and development. With increased development, special considerations must be taken for the protection and preservation of wetlands, water quality, shorelines, floodplains, wildlife habitats, forests, upland natural areas, and moderate topographic slopes.

The geologic formations of Charles County and surrounding Maryland were formed during the tertiary period, resulting in landscapes comprised of sand, clay, silt, greensand, and diatomaceous earth. The rivers, streams, marshland, shoreline, and forests which makeup Charles County's natural resources also support a wide range of plant and wildlife communities. Mineral resources of Charles County, sand and gravel, are used to aggregate materials for the construction industry (Maryland Geological Survey, 2018). Clay, for example, is often used in the production of brick and ceramics, while other resources include iron ore deposits and ground water (Maryland Geological Survey, 2018). These same environments contribute to the County's overall quality of life, rural character, and unique aesthetic, while providing a foundation for its built environment. In return, natural resource lands also support opportunities to maintain clean water and air quality, promote eco-tourism, and enhance property values in developed areas.

Figure 2.1-1: Charles County Base Map



2.2 Population and Demographics

In 2016, the estimated population in Charles County was 154,357. The Town of La Plata was the most populated municipality in the County, with 9,059 residents (U.S. Census Bureau, 2016). As shown in Table 2.2-1, Charles County's population increased by 5.3 percent since 2010. Similarly, the populations of the La Plata and Indian Head increased by 3.5 percent and 0.9 percent respectively. Port Tobacco's population increased during this timeframe from 13 to 21 residents.

Table 2.2-1: **Population Change in Charles County (U.S. Census, 2010 and 2016)**

MUNICIPALITY	2010 POPULATION	2016 ESTIMATED POPULATION	PERCENT CHANGE (%)
Charles County	146,551	154,357	5.3%
La Plata, Town of	8,753	9,059	3.5%
Indian Head, Town of	3,844	3,879	0.9%
Port Tobacco, Village of	13	21*	+61.5%
** Estimated provided by the Village of Port Tobacco*			

The unincorporated communities of Waldorf and St. Charles are among the County's major population centers. Significant growth occurred in this area between 2000 and 2010, as the County's population increased by 22 percent during this timeframe. Charles County was also the fastest growing county in the state between 2000 and 2010. At-place employment (jobs located in Charles County) increased by approximately 12,800 or 26 percent over the last decade.

Charles County is characterized by relatively low population density, with approximately 240 people per square mile countywide. As shown in Table 2.2-2, La Plata and Indian Head are significantly more densely populated than the County as a whole. These more densely populated areas are potentially more vulnerable to the impacts of hazards due to the concentration of life, property, and other assets.

Table 2.2-2: **Population and Housing Density in Charles County (U.S. Census, 2016)**

MUNICIPALITY	POPULATION DENSITY (POPULATION PER SQ. MILE)	TOTAL HOUSING UNITS
Charles County	240.06	58,014
La Plata, Town of	1,216.0	3,048
Indian Head, Town of	3,153.7	1,590
Port Tobacco, Village of	131.3	9*
** Estimated provided by the Village of Port Tobacco*		

As shown in Table 2.2-2, there are 58,014 households in Charles County. The racial makeup of the County is 47.8 percent White, 42.6 percent Black or African American, 5.1 percent Hispanic or Latino, 3.1 Asian, and less than 1 percent from other races or ethnicities (U.S. Census, 2016). The median age for the County is 37.9 years old with 11 percent age 65 or older. The median household income in the County is $91,373, and the percent of population below the poverty level is 7.7 percent, compared to 9.9 percent statewide (U.S. Census, 2016).

There are approximately 58,014 housing units in Charles County, 54,105 of which are currently occupied. An estimated 3,909 housing units are vacant, making up roughly 6.7 percent of all housing units in the County (U.S. Census, 2016). Approximately 71.3 percent of all housing units in the County are single-unit detached structures, and the median value for owner occupied housing is $287,600. This is consistent with the median value of $290,400 for Maryland as a whole (U.S. Census, 2016). As shown in Table 2.2-3, most homes in Charles County were built between 1980 and 2009.

Table 2.2-3: **Housing Units Constructed by Year in Charles County (U.S. Census, 2016)**

YEAR BUILT	HOUSING UNITS	PERCENT OF TOTAL HOUSING UNITS
Built 2014 or later	429	0.7%
Built 2010 to 2013	2,293	4.0%
Built 2000 to 2009	12,772	22.0%
Built 1990 to 1999	11,976	20.6%
Built 1980 to 1989	10,376	17.9%
Built 1970 to 1979	9,480	16.3%
Built 1960 to 1969	5,257	9.1%
Built 1950 to 1959	2,375	4.1%
Built 1940 to 1949	1,505	2.6%
Built 1939 or earlier	1,551	2.7%
Total	**58,014**	**100%**

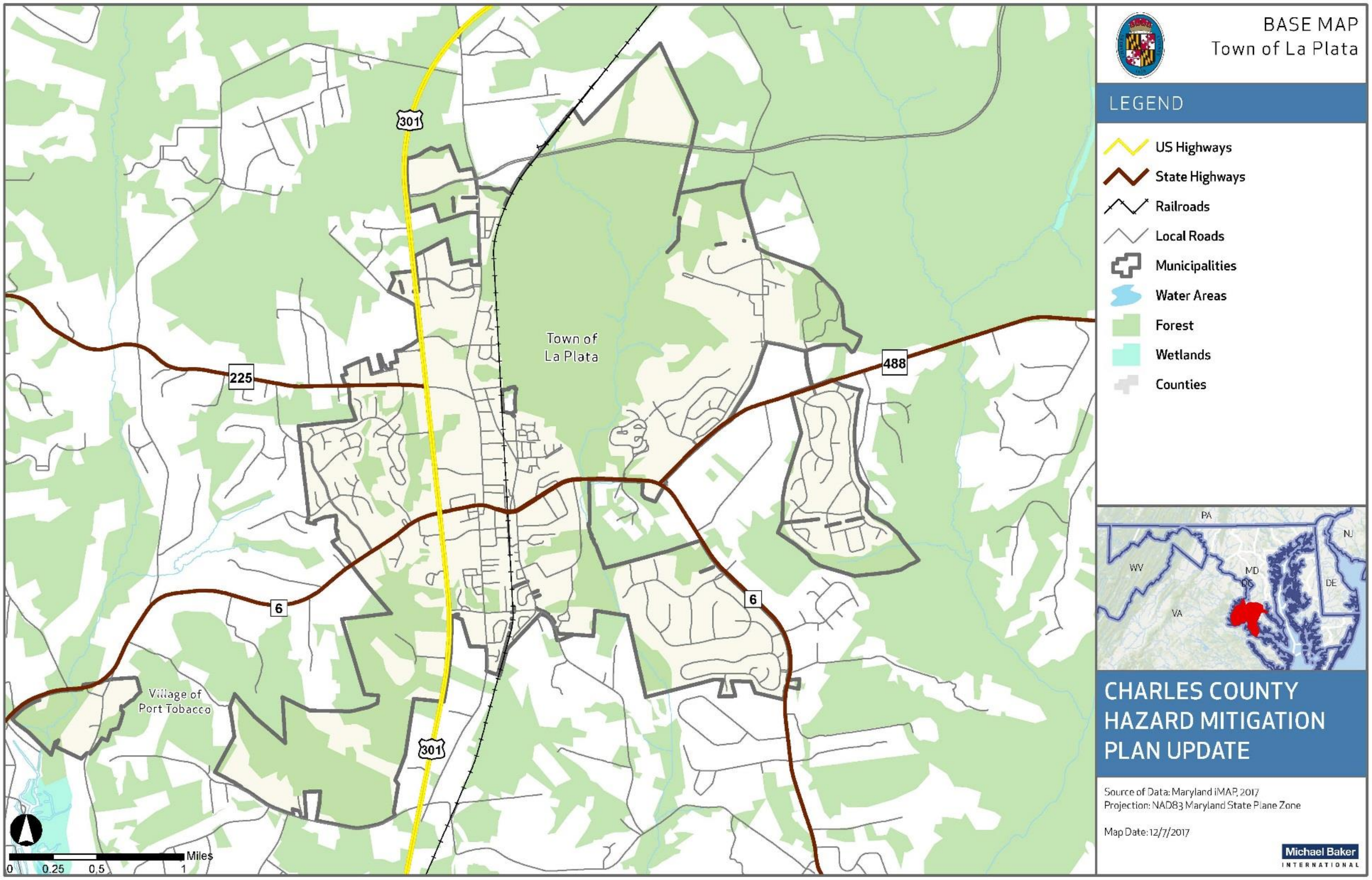
2.3 Jurisdictional Profiles

The following are brief overviews for each jurisdiction participating in the HMP Update.

2.3.1 Town of La Plata

The Town of La Plata is located in central Charles County and serves as the County seat. La Plata is also the most populated jurisdiction in the County with 9,059 residents as of 2016. It is also home to the College of Southern Maryland and hundreds of small businesses that serve the region (U.S. Census, 2016). As shown in Figure 2.3.1-1, Route 301 crosses the community from north to south, while state highways including Routes 225, 6, and 488 also transect La Plata. The Town of La Plata was originally founded in the 1870's as the Pennsylvania Railroad was granted a right-of-way to build its tracks and station, and the community was incorporated on April 4, 1888.

Figure 2.3.1-1: Town of La Plata Base Map



2.3.2 Town of Indian Head

The Town of Indian Head is located in the western portion of Charles County on a peninsula between the Potomac River and the Mattawoman Creek (see Figure 2.3.3-2). This land that was once part of the territory of the Algonquin Indians. The Naval Station at Indian Head was established in 1890 when Ensign Dashiele came from the Annapolis area searching for a new location to build a proving ground for the testing of guns, munitions, and armor plate for Navy ships. During World War I & II the naval facilities were expanded. The Town of Indian Head was incorporated in 1920 and currently encompasses 1.5 square miles with a population of 3,879 (U.S Census, 2016).

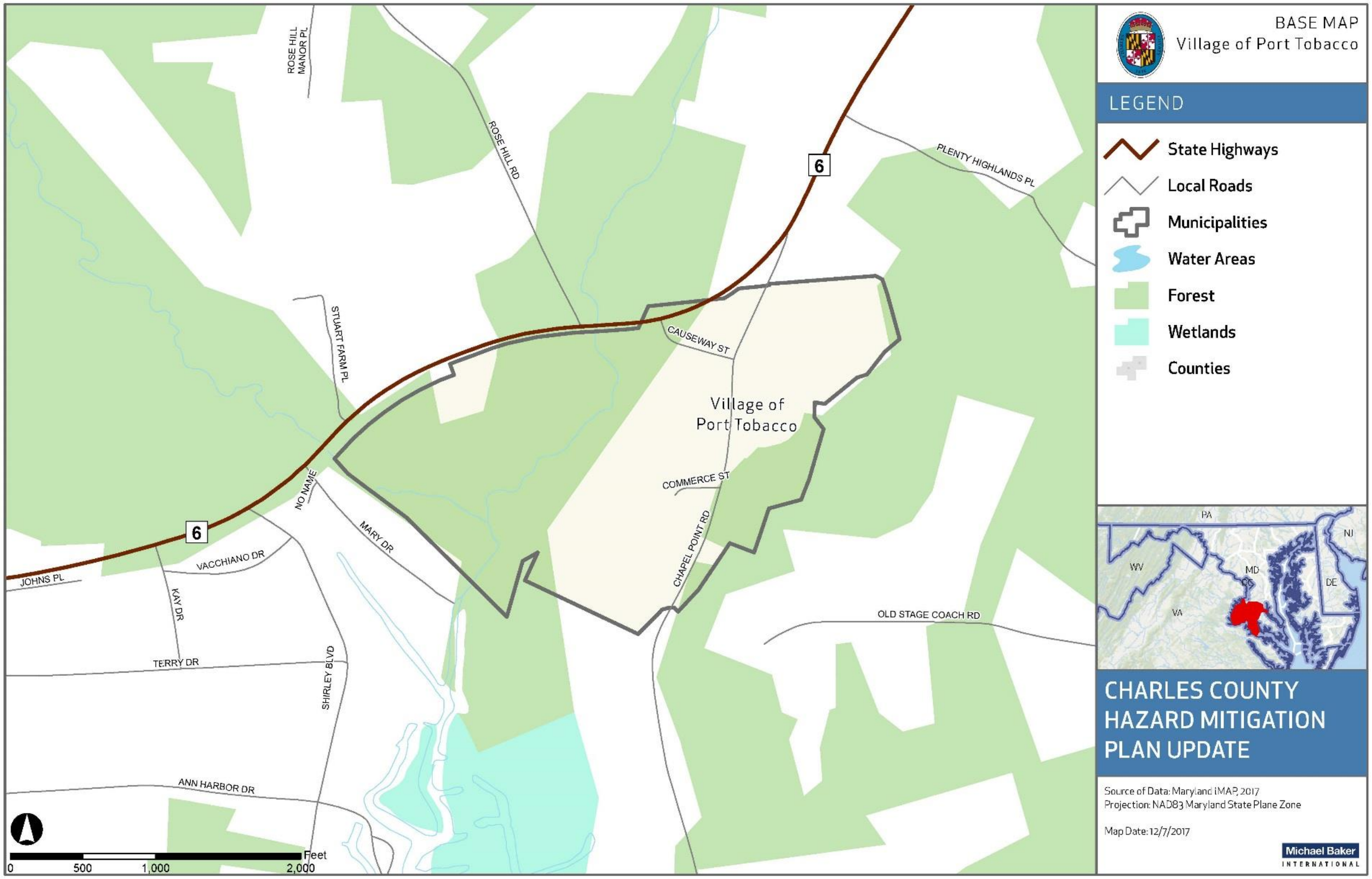
2.3.3 Town of Port Tobacco Village

Port Tobacco is centrally located in Charles County near the Port Tobacco River, which flows into the Potomac River. As shown in Figure 2.3.3-3, the community is located at the crossroads of Route 6 and Chapel Point Road. The Town of Port Tobacco was the original seat of Charles County and was officially incorporated in 1888. The population of the community was 21 as of 2016, making Port Tobacco the smallest incorporated community in Maryland. The Town Council is comprised of five elected members. Port Tobacco was historically the territory of Algonquian-speaking peoples, especially the Potopaco and the more dominant Piscataway.

Figure 2.3.3-1: Port Tobacco Courthouse and Museum

Figure 2.3.3-2: Town of Indian Head Base Map

Figure 2.3.3-3: Village of Port Tobacco Base Map



2.4 Land Use and Development Trends

Charles County has transformed drastically over the past four decades due to rapid growth and urbanization. The outward expansion of the Washington D.C. suburbs has transformed portions of Charles County, especially the northern sections of the County. New residents are attracted by Charles County's lower taxes and housing costs, rural character, and relative freedom from the congestion in counties closer to Washington. This immigration has also brought increased traffic volumes on county roadways. As the County has grown, so have the demands for services. These challenges have attracted the attention of county officials and citizens, leading to the need for more nuanced methods of growth management in Charles County's future land use development plan. Charles County is in a transitional growth stage as some areas of the County are evolving from rural to more suburban communities. The development trends associated with this transition have imposing economic and fiscal costs to the County.

Many of the County's existing settlements were built prior to when land use and growth management standards were established. As a result, preserving open space, vistas, or scenic views and maintaining the County's historic and rural character are challenges that face the County. Figure 2.4-1 illustrates existing land use patterns in Charles County. Most of the County consists of open space and residential development, while most of the County's commercial development is concentrated in La Plata, Indian Head, Waldorf, and along Route 301. Figure 2.4-2 shows subdivision activity in Charles County, which also depicts heavier concentrations of development in the northern portions of the County and near existing infrastructure, particularly in and around Waldorf and La Plata.

The Charles County 2016 Comprehensive Plan will guide and manage future development and land uses in the County over the next decade. Goals and objectives of the plan strive to maintain planned land use patterns that offer opportunities to enrich quality of life while advancing economic growth and development. Future growth will be concentrated in areas of the County already equipped with public water and sewage treatment, and roughly 75% of future residential growth will be directed towards the Towns of Indian Head and La Plata. The growth of commercial and business areas will also remain within already established districts, including in La Plata and Indian Head, to prevent sprawl along the County's major roadways. The goals and objectives of Charles County's land use plan will also attempt to protect the County's natural resources and unique character while providing proper services to rural areas. To enhance public access to transportation, the highest development densities will be planned along the Route 301 transit corridor. Figure 2.4-3 depicts the County's land use plan, which influences zoning and development regulations and ultimately the relationship between existing patterns of development and the location, dispersal, and range of future development. As shown in the map and as described above, target areas for growth are largely concentrated along Route 301 and near existing development, while much of the County is located in conversation districts (agricultural, rural, and rural residential).

Projections from the Comprehensive Plan for 2040 aim to provide adequate land area needed to house roughly 37,000 new residents. The county aims to manage the amount and rate of development as needed to maintain consistency with its ability to provide necessary public services and facilities in a timely and cost-effective manner.

Figure 2.4-1: Charles County Land Use/Land Cover Map

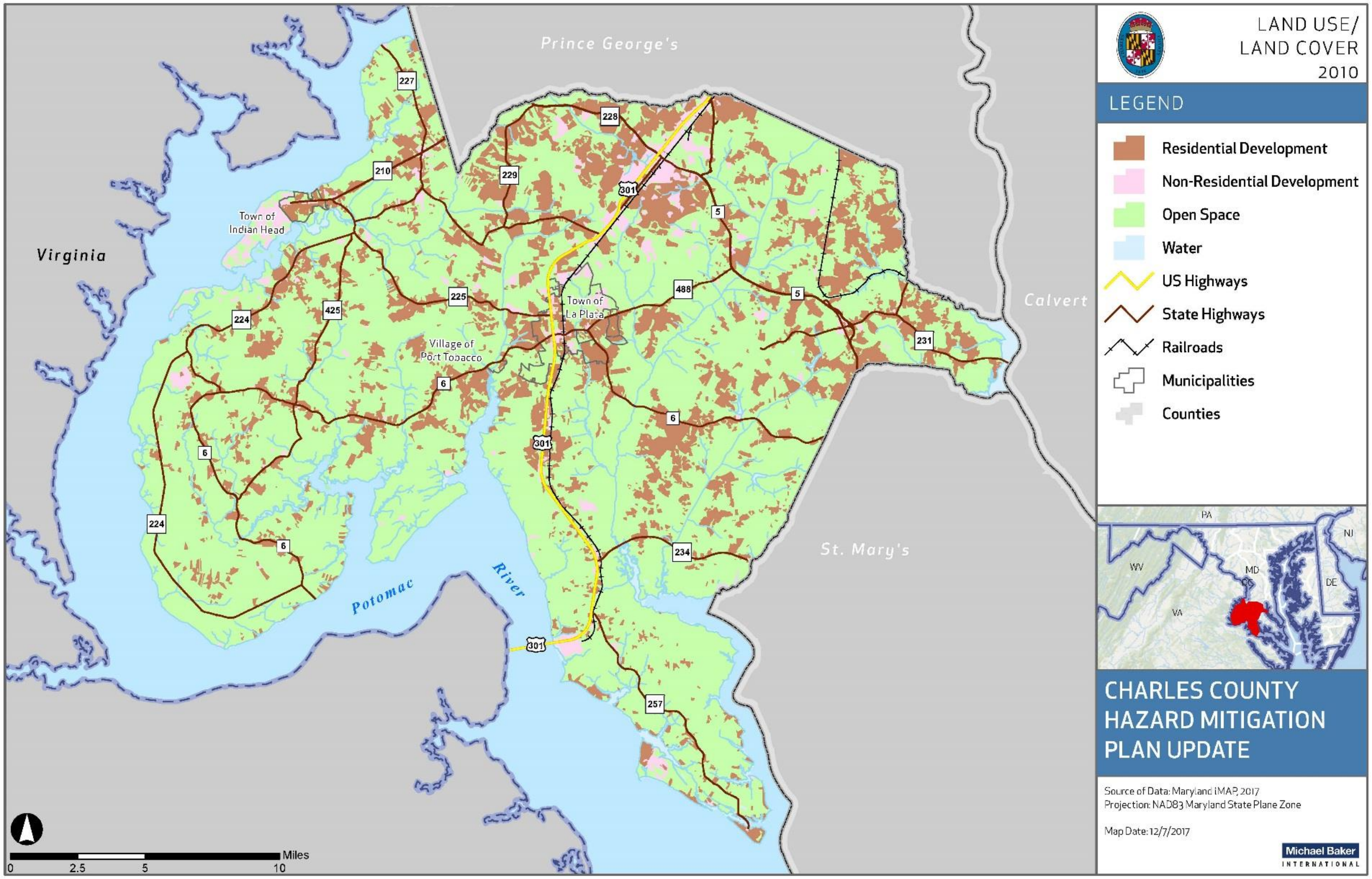


Figure 2.4-2: Charles County Subdivision Activity

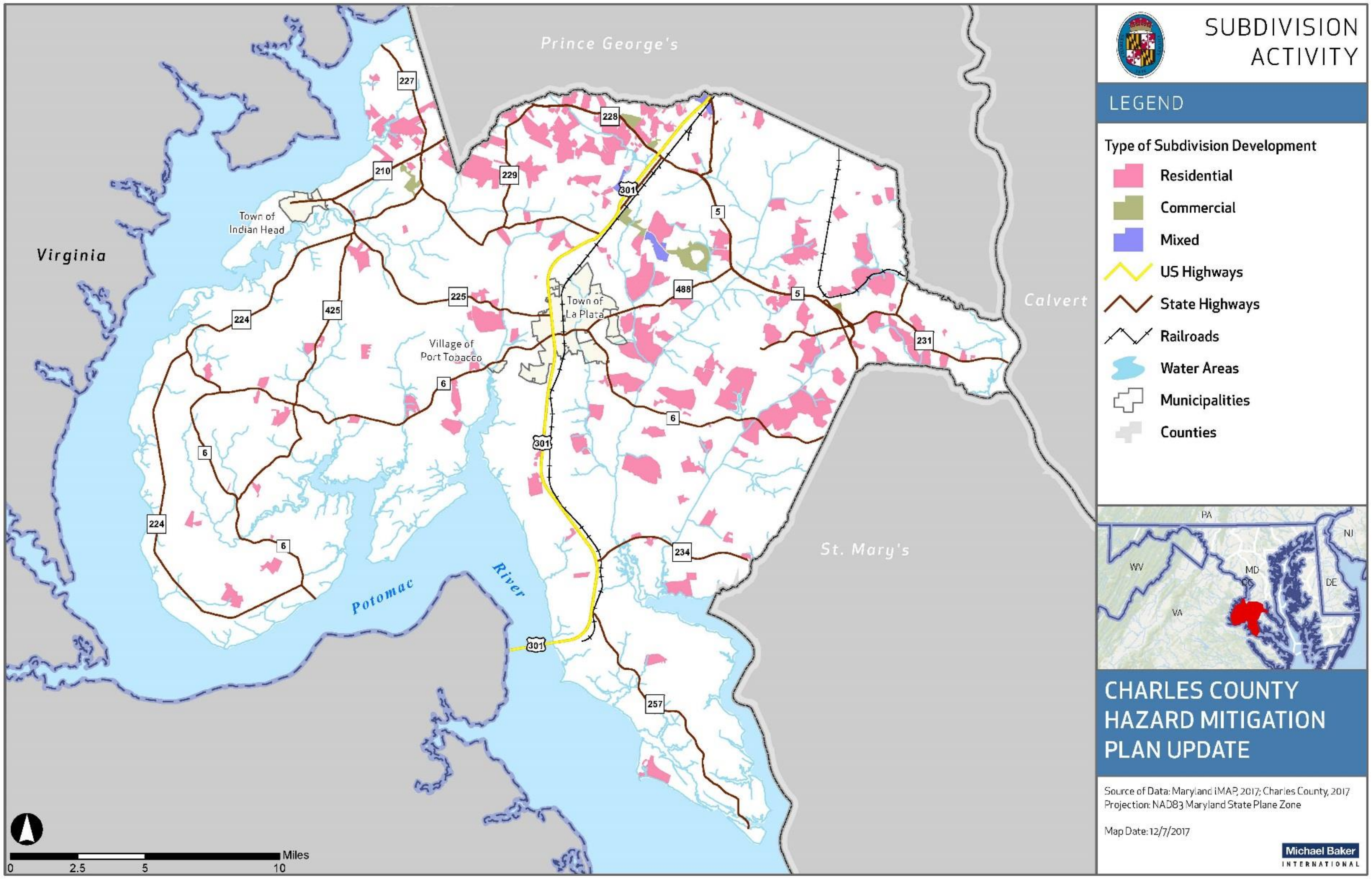
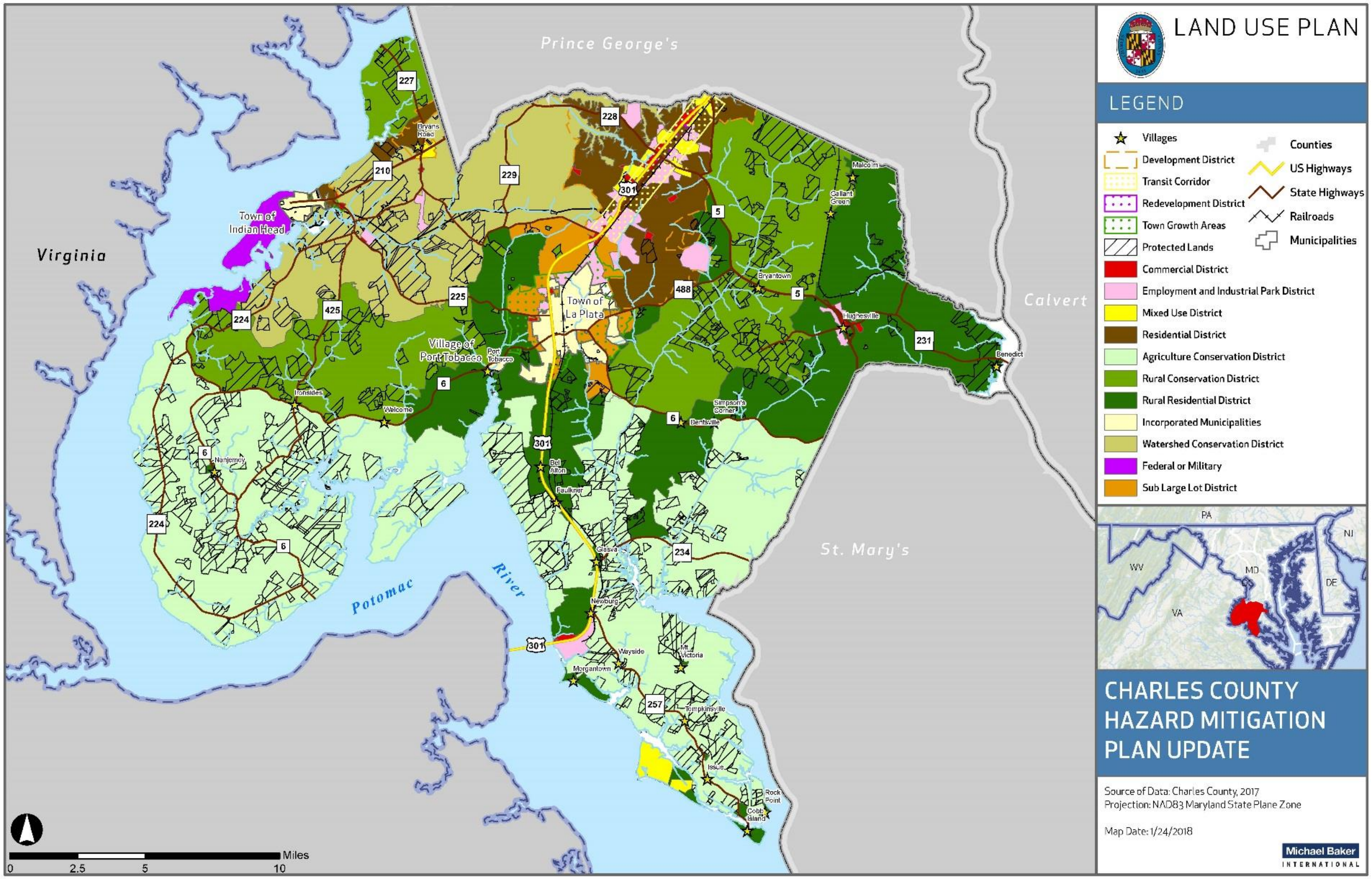
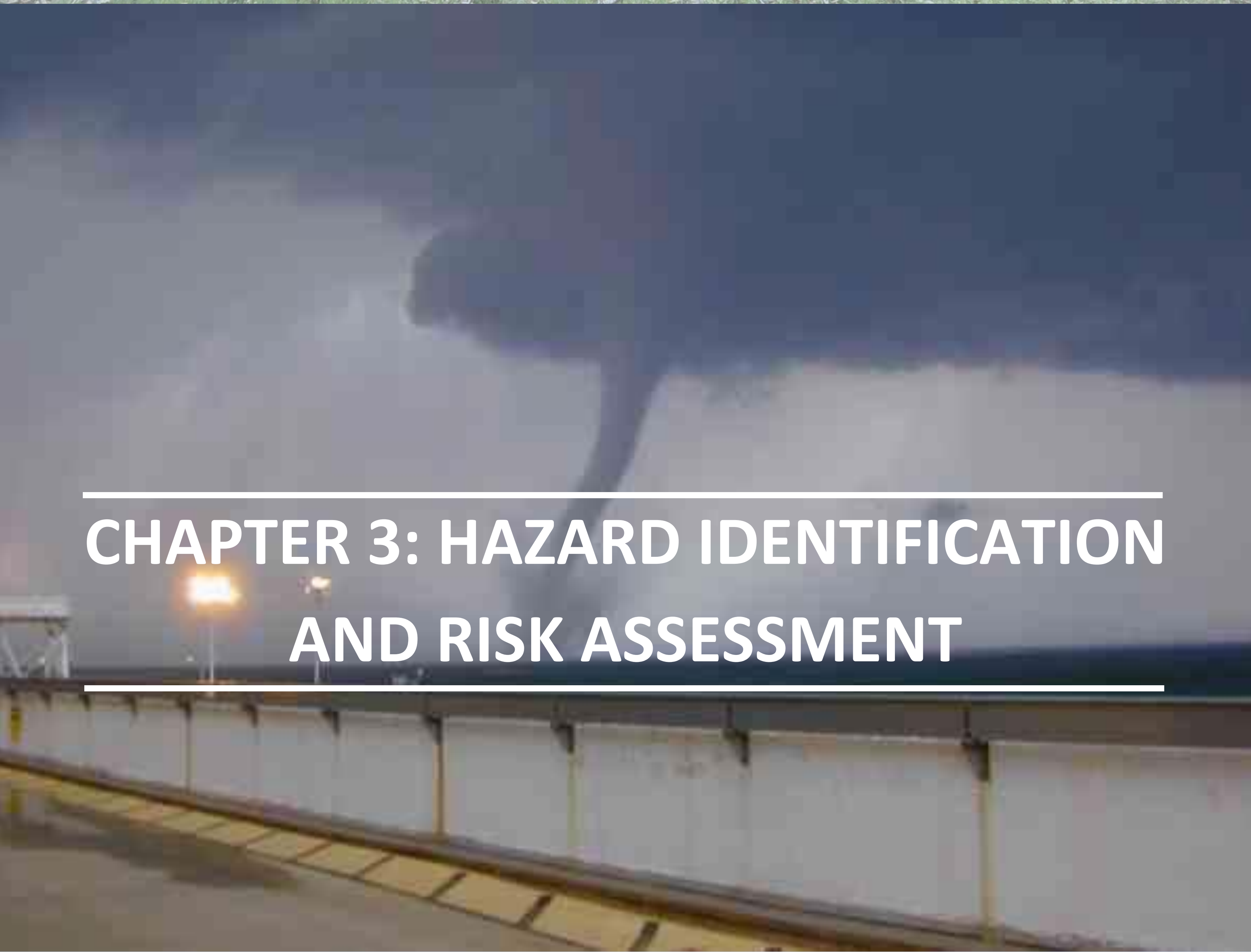


Figure 2.4-3: Charles County Land Use Plan Map





CHAPTER 3: HAZARD IDENTIFICATION AND RISK ASSESSMENT

3 Hazard Identification and Risk Assessment

This section of the HMP describes the Hazard Identification and Risk Assessment (HIRA) summary undertaken by Charles County and participating municipalities in the preparation of this HMP Update. This section consists of the following subsections:

- Update Process Summary
- Hazard Identification
- Hazard Profiles
  - Drought
  - Earth Disturbance
  - Erosion
  - Extreme Weather
  - Flood
  - Hurricane, Tropical Storm, Nor'easter
  - Severe Winter Storms
  - Temperature Extremes
  - Wildfire
  - Building and Structure Collapse
  - Civil Disturbance and Criminal Activity
  - Dam Failure
  - Environmental Hazards
  - Nuclear Events
  - Public Health Emergency
  - Transportation Accidents
  - Utility Interruption
- Hazard Vulnerability Summary

A key step in preventing disaster losses in Charles County is developing a comprehensive understanding of the hazards that pose risks to its communities. The following terms can be found throughout this section of the HMP.

Hazard:	Event or physical conditions that have the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, and other types of harm or loss.
Risk:	Product of a hazard's likelihood of occurrence and its consequences to society.
Vulnerability:	Degree of susceptibility and resilience of the community and environment to hazards.

3.1 Update Process Summary

This risk assessment provides a factual basis for activities proposed by Charles County in its mitigation strategy. Hazards that may affect Charles County are identified and defined in terms of location and geographic extent, magnitude of impact, previous events, and likelihood of future occurrence. Wherever data could be validated, information from the previous plan has been incorporated and/or updated in the 2018 HMP. In addition, new data sources and analysis have been incorporated throughout the HIRA.

Table 3.1-1 documents the 2012 review of hazards profiled in the 2006 HMP by the Charles County HMPC. Hazards were re-evaluated and analyzed to determine whether they should be either *continued*, *removed*, or *changed*. Several new hazards were also identified.

Table 3.1-1: **2012 Review of Hazards Profiled in the 2006 HMP**

2006 HAZARD	STATUS	2012 HMP UPDATE NOTES	2012 HAZARD
Thunderstorms and Lightning	Continued		Thunderstorms and Lightning
Tornadoes	Continued		Tornadoes
Hurricanes	Continued		Hurricanes
Hailstorms	Changed	Discussed with Thunderstorms and Lightning.	Thunderstorms and Lightning
Severe Winter Storms	Continued		Severe Winter Storms
Extreme Summer Heat	Changed	Renamed to Temperature Extremes.	Temperature Extremes
Extreme Winter Cold	Changed	Renamed to Temperature Extremes.	Temperature Extremes
Floods	Continued		Floods
Drought	Continued		Drought
Wildfires	Continued		Wildfires
Earthquakes	Continued		Earthquakes
Landslides	Removed		N/A
Land Subsidence	Removed		N/A
Erosion	Continued		Erosion
Expansion Soil	Changed		Erosion
Hazardous Waste	Continued		Hazardous Waste
	New		Public Health Emergencies
	New		Nuclear Incidents

Table 3.1-2 documents the review of 2012 hazards by the Charles County HMPC for the 2018 HMP Update. At the Risk Assessment and Mitigation Solutions Meetings, the HMPC discussed and evaluated each hazard and discussed whether they should be *continued*, *removed*, or *changed*. Several new hazards were also identified, and some hazards were grouped and profiled with similar hazards for the 2018 HMP Update.

Table 3.1-2: **2018 Review of Hazards Profiled in the 2012 HMP Update**

2012 HAZARD	STATUS	2018 HMP UPDATE NOTES	2018 HAZARD
Thunderstorms and Lightning	Changed	Renamed Extreme Weather and combined with Tornadoes, High Winds, and Hailstorms.	Extreme Weather
Tornadoes	Changed	Renamed Extreme Weather and combined with Thunderstorm and Lightning, High Winds, and Hailstorms.	Extreme Weather
Hurricanes	Changed	Renamed Hurricane, Tropical Storm, and Nor'easter.	Hurricane, Tropical Storm, and Nor'easter
Severe Winter Storms	Continued		Severe Winter Storms
Temperature Extremes	Continued		Temperature Extremes
Flood	Continued		Flood
Drought	Continued		Drought
Wildfire	Continued		Wildfire
Earthquake	Changed	Renamed Earth Disturbance and combined with Landslide and Subsidence/Sinkhole.	Earth Disturbance
Erosion	Continued		Erosion
Hazardous Waste	Changed	Renamed Environmental Hazards and combined with Natural Gas Emergency.	Environmental Hazards
Public Health Emergencies	Continued		Public Health Emergencies
Nuclear Incidents	Continued		Nuclear Incidents
Natural Gas Emergency	New	Combined with Hazardous Waste and renamed Environmental Hazards.	Environmental Hazards
Dam Failure	New		Dam Failure
High Winds	New	Renamed Extreme Weather and combined with Thunderstorm and Lightning, Tornadoes, and Hailstorms.	Extreme Weather
Hailstorms	New	Renamed Extreme Weather and combined with Thunderstorm and Lightning, High Winds, and Tornadoes.	Extreme Weather
Subsidence/Sinkholes	New	Renamed Earth Disturbance and combined with Earthquakes and Landslide.	Earth Disturbance
Landslide	New	Renamed Earth Disturbance and combined with Subsidence/Sinkholes and Earthquakes.	Earth Disturbance
Utility Interruption	New		Utility Interruption

Table 3.1-2: 2018 Review of Hazards Profiled in the 2012 HMP Update			
2012 HAZARD	**STATUS**	**2018 HMP UPDATE NOTES**	**2018 HAZARD**
Building and Structure Collapse	New		Building and Structure Collapse
Criminal Activity/Civil Disturbance	New		Criminal Activity/Civil Disturbance
Transportation Accidents	New		Transportation Accidents

Table 3.1-3 below identifies hazards profiled in the 2018 HMP and the year they were identified for inclusion in the HMP.

Table 3.1-3: Natural and Human-Caused Hazards Profiled in the 2018 HMP and Year Identified			
HAZARD	**YEAR**	**HAZARD**	**YEAR**
Drought	2006	Building and Structure Collapse	2018
Earth Disturbance	2006, 2018	Civil Disturbance and Criminal Activity	2018
Erosion	2006	Dam Failure	2018
Extreme Weather	2006, 2018	Environmental Hazards	2006, 2018
Flood	2006	Nuclear Events	2012
Hurricane, Tropical Storm, and Nor'easter	2006	Public Health Emergency	2012
Severe Winter Storms	2006	Transportation Accidents	2018
Temperature Extremes	2006	Utility Interruption	2018
		Wildfire	2006

After the HMPC identified the hazards for inclusion in the 2018 HMP, it developed hazard risk assessment profiles in order to define the characteristics of each hazard as it applies to Charles County. After identifying and profiling hazards, a vulnerability assessment was performed to identify the impact of natural or human-caused hazard events on people, buildings, infrastructure, and the community. Each natural and human-caused hazard is discussed in terms of its potential impact on individual communities in Charles County, including the types of structures and infrastructure that may be at risk. The assessment allows the County and its jurisdiction to focus mitigation efforts on areas most likely to be damaged or most likely to require early response to a hazard event. Depending upon data availability, assessment results may consist of an inventory of vulnerable structures and populations.

3.2 Hazard Identification

3.2.1 Table of Presidential Disaster Declarations

Under the Stafford Act, there are two forms of presidential action that authorize federal disaster assistance dollars. Presidential Emergency Declarations are intended to spur activities that will protect property and strengthen public safety to lessen impacts or avoid a catastrophic event. Presidential Disaster Declarations are made as a result of a disaster event and provide supplemental coordination and financial assistance beyond the ability of state and local governments (McCarthy, 2011). Because of the difference in these declarations, a single event may qualify for both kinds of declarations.

There is no financial threshold for an Emergency Declaration, but there are two thresholds for Presidential Disaster Declarations established under the Stafford Act: a state and a county threshold. These thresholds are based on a formula that uses the population of the jurisdiction (as recorded in the decennial Census) times a set per capita indicator. As of federal fiscal year 2016, these thresholds are $3.56 per capita for counties and $1.41 per capita for the state. With a 2010 population of over 140,000, the Charles County threshold is over $495,000. State and county thresholds must be simultaneously attained for a Presidential Disaster Declaration to be issued.

Table 3.2.1-1 identifies Presidential Disaster and Emergency Declarations that have affected Charles County from most to least recent.

Table 3.2.1-1: Presidential Disaster and Emergency Declarations affecting Charles County

DISASTER NUMBER	DATE	DISASTER NAME
4261	March 4, 2016	Severe Winter Storm and Snowstorm
4091	November 11, 2012	Hurricane Sandy
3349*	October 28, 2012	Hurricane Sandy
4075	August 2, 2012	Severe Storms and Straight-Line Winds
4038	October 5, 2011	Remnants of Tropical Storm Lee
4034	September 16, 2011	Hurricane Irene
3335*	August 27, 2011	Hurricane Irene
1910	May 6, 2010	Severe Winter Storms and Snowstorms
1875	February 19, 2010	Severe Winter Storm and Snowstorm
3251*	September 13, 2005	Hurricane Katrina Evacuation
1492	September 19, 2003	Hurricane Isabel
3179*	March 14, 2003	Snow
1409	May 1, 2002	Tornado
1324	April 10, 2000	Severe Winter Storm
1303	September 24, 1999	Hurricane Floyd
1081	January 11, 1996	Blizzard of 1996 (Severe Snow Storm)
1016	March 16, 1994	Severe Winter Weather and Ice Storms
3100*	March 16, 1993	Severe Snowfall & Winter Storm
524	January 26, 1977	Ice Conditions

Table 3.2.1-1: Presidential Disaster and Emergency Declarations affecting Charles County		
DISASTER NUMBER	DATE	DISASTER NAME
489	October 4, 1975	Heavy Rains & Flooding
341	June 23, 1972	Tropical Storm Agnes
**Presidential Emergency Declarations*		

Since 1955, declarations have been issued for various hazard events including hurricanes or tropical storms, severe winter storms, tornadoes, and flooding. A unique Presidential Emergency Declaration was issued in September 2005. Through Emergency Declaration 3251, President George W. Bush declared that a state of emergency existed in the State of Maryland and ordered federal aid to supplement state and local response efforts to help people evacuated from their homes due to Hurricane Katrina. All counties within the state, including Charles County, were indirectly affected by Hurricane Katrina as a result of evacuee assistance.

3.2.2 Methodology

Hazards were ranked to provide structure and prioritize the mitigation goals and actions discussed in this plan. Charles County utilized a risk factor (RF) tool to measure the degree of risk for identifying hazards in the County. The RF can also assist local community officials in ranking and prioritizing hazards that pose the most significant threat to a planning area based on a variety of factors deemed important by the HMPC and other stakeholders involved in the hazard mitigation planning process. The RF system relies mainly on historical data, GIS data, local knowledge, general consensus from the HMPC, and information collected through development of the hazard profiles included in Section 3.3. The RF approach produces numerical values that allow identified hazards to be ranked against one another; the higher the RF value, the greater the hazard risk. During the planning process, the Charles County HMPC compared the results of the hazard profile against their local knowledge to generate a set of ranking criteria. These criteria were used to evaluate hazards and identify the highest risk hazard.

RF values were obtained by assigning varying degrees of risk to five categories for each hazard profiled in the HMP update. Those categories include probability, impact, spatial extent, warning time, and duration. Each degree of risk was assigned a value ranging from one to four. The weighting factor agreed upon by the HMPC is shown in Table 3.3-1. To calculate the RF value for a given hazard, the assigned risk value for each category was multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the following example equation:

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

Table 3.2.2-1 summarizes each of the five categories used for calculating a RF for each hazard. According to the weighting scheme applied, the highest possible RF value is 4.0.

Table 3.2.2-1: Risk Factor Criteria

RISK ASSESSMENT CATEGORY	DEGREE OF RISK				WEIGHT VALUE
	LEVEL	CRITERIA		INDEX	
PROBABILITY *What is the likelihood of a hazard event occurring in a given year?*	Unlikely	Less than 1% annual probability		1	30%
	Possible	Between 1% and 49.9% annual probability		2	
	Likely	Between 50% and 90% annual probability		3	
	Highly Likely	Greater than 90% annual probability		4	
IMPACT *In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?*	Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.		1	30%
	Limited	Minor Injuries Only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one. Day.		2	
	Critical	Multiple deaths and injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.		3	
	Catastrophic	High number of deaths and injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.		4	
SPATIAL EXTENT *How large of an area could be impacted by a hazard event? Are impacts localized or regional?*	Negligible	Less than 1% of area affected		1	20%
	Small	Between 1% and 10.9% of area affected		2	
	Moderate	Between 11% and 25% of area affected		3	
	Large	Greater than 25% of area affected		4	
WARNING TIME *Is there usually some lead time associated with the hazard event? Have warning measures been implemented?*	More than 24 hours	Self-defined	*Note: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.*	1	10%
	12 to 24 hours	Self-defined		2	
	6 to 12 hours	Self-defined		3	
	Less than 6 hours	Self-defined		4	
Duration *How long does the hazard event usually last?*	Less than 6 hours	Self-defined	*Note: Levels of duration time and criteria that define them may be adjusted based on hazard addressed.*	1	10%
	Less than 24 hours	Self-defined		2	
	Less than 1 week	Self-defined		3	
	More than 1 week	Self-defined		4	

3.2.3 Ranking Results

Using the methodology described in above in Section 3.3.1, Table 3.2.3-1 lists the Countywide RF calculated for each of the 17 potential hazards identified in the 2018 HMP Update. Hazards identified as *high* risk have risk factors greater than 3.0. Risk Factors ranging from 2.0 to 2.9 were deemed *moderate* risk hazards. Hazards with Risk Factors 1.9 and less are considered *low* risk.

Table 3.2.3-1: Countywide ranking of hazard types based on Risk Factor (RF) methodology.

HAZARD RISK	HAZARD NATURAL (N) or MAN-MADE (M)	RISK ASSESSMENT CATEGORY					RISK FACTOR
		PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
High	Extreme Weather (N)	4	3	4	4	1	3.4
	Temperature Extremes (N)	4	2	4	1	3	3.0
	Flood (N)	3	3	3	4	2	3.0
	Public Health Emergency (M)	4	3	2	1	4	3.0
Moderate	Hurricane, Tropical Storm, and Nor'easter (N)	2	3	4	1	2	2.6
	Utility Interruption (M)	4	1	2	3	2	2.4
	Severe Winter Storms (N)	3	1	4	1	3	2.4
	Environmental Hazards (M)	4	1	1	4	2	2.3
	Transportation Accidents (M)	4	2	1	1	1	2.2
	Civil Disturbance and Criminal Activity (M)	3	2	1	3	1	2.1
	Building and Structure Collapse (M)	2	2	1	3	3	2.0
	Dam Failure (M)	1	2	2	4	3	2.0
Low	Earth Disturbance (N)	2	1	3	3	1	1.9
	Drought (N)	1	1	4	1	4	1.9
	Erosion (N)	3	1	1	1	3	1.8
	Nuclear Events (M)	1	2	1	2	4	1.7
	Wildfire (N)	1	1	1	4	2	1.4

Based on these results, Charles County has four high risk hazards, eight moderate risk hazards, and five low risk hazards for a total of 17 hazards. Mitigation actions focused on developing actions for moderate and high risk hazards (see Section 6.4).

Based on the RF analysis, the natural hazard with the highest risk potential is "Extreme Weather", which has a value of 3.4. For the 2018 HMP Update, "Extreme Weather" surpassed "Temperature Extremes" as the hazard with the highest risk factor. The HMPC made this decision because of the County's increasing vulnerability to these hazards, and because Extreme Weather combines several new hazards with existing hazards profiled in previous HMP Updates (tornado, wind storm, hailstorm, thunderstorm, and lightning). "Temperature Extremes" remains a high risk hazard with a RF of 3.0 due to its high probability of occurring and the spatial extent of the potential damage within the County. The RF value for "Flood" was increased from 2.2 to 3.0 due to the increased vulnerability since 2012 and the availability of better data to assess risk. The highest ranked human-made hazard was "Public Health Emergency", which was a high risk hazard with a value of 3.0. This value increased from 2.1 in 2012 and surpassed "Environmental Hazards" as the highest risk human-made hazard largely due to recent impacts of the opioid epidemic.

A risk assessment result for the entire county does not mean that each municipality is at the same amount of risk to each hazard. During the update process, the jurisdictions within Charles County were provided the opportunity to provide any information on hazards that affect the County. Using the RF methodology, jurisdictions were also able to indicate if their risk was less than, greater than or equal to the County's Risk Factor for each hazard. The results of each jurisdictions Risk Factor review are provided in the table below, which indicates whether a community's risk is greater than (>), less than (<), or equal to (=) the risk factor assigned to Chares County as a whole. This table was developed based on the findings in the hazard profiles of Section 4.3 and municipal input from the "Evaluation of Identified Hazards and Risk" and "Jurisdictional Risk Evaluation" worksheets, and input provided during the 2012 HMP Update about jurisdictional risk.

Table 3.2.3-2: Jurisdictional Risk Evaluation

Municipality	Extreme Weather (N)	Temperature Extremes (N)	Flood (N)	Public Health Emergency (M)	Hurricane, Tropical Storm, and Nor'easter (N)	Utility Interruption (M)	Severe Winter Storms (N)	Environmental Hazards (M)	Transportation Accidents (M)	Civil Disturbance and Criminal Activity (M)	Building and Structure Collapse (M)	Dam Failure (M)	Earth Disturbance (N)	Drought (N)	Erosion (N)	Nuclear Events (M)	Wildfire (N)
County Rank	3.4	3	3	3	2.6	2.4	2.4	2.3	2.2	2.1	2	2	1.9	1.9	1.8	1.7	1.4
Town of La Plata	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Town of Port Tobacco	=	=	>	=	=	=	=	=	=	<	=	<	=	=	>	=	=
Town of Indian Head	=	=	>	=	=	=	=	=	=	=	=	<	<	=	=	=	=

3.3 Hazard Profiles

NATURAL HAZARDS

3.3.1 Drought

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Natural	1	1	4	1	4	**1.9**
LOW RISK (Less than 2.0)						

3.3.1.1 Location, Extent, and Range of Magnitude

According to the United State Army Corps of Engineers (USACE), a drought is a period of time when natural or managed water systems do not provide enough water to meet established human and environmental uses because of natural shortfalls in precipitation or stream flow. Drought is a natural climatic condition, which occurs in virtually all climates, and is the consequence of a natural reduction in the amount of precipitation experienced over a long period of time, usually a season or more in length. High temperatures, prolonged winds, and low relative humidity can exacerbate the severity of drought. This profile focuses on two types of droughts: hydrologic and water management (as categorized by the World Meteorological Organization).

A **hydrologic drought** is defined in terms of reduction of stream flows, reduction in lake or reservoir storage, and lowering of groundwater levels. This results from a shift in normal weather patterns over an area causing the amount of precipitation to fall significantly below the long-term average.

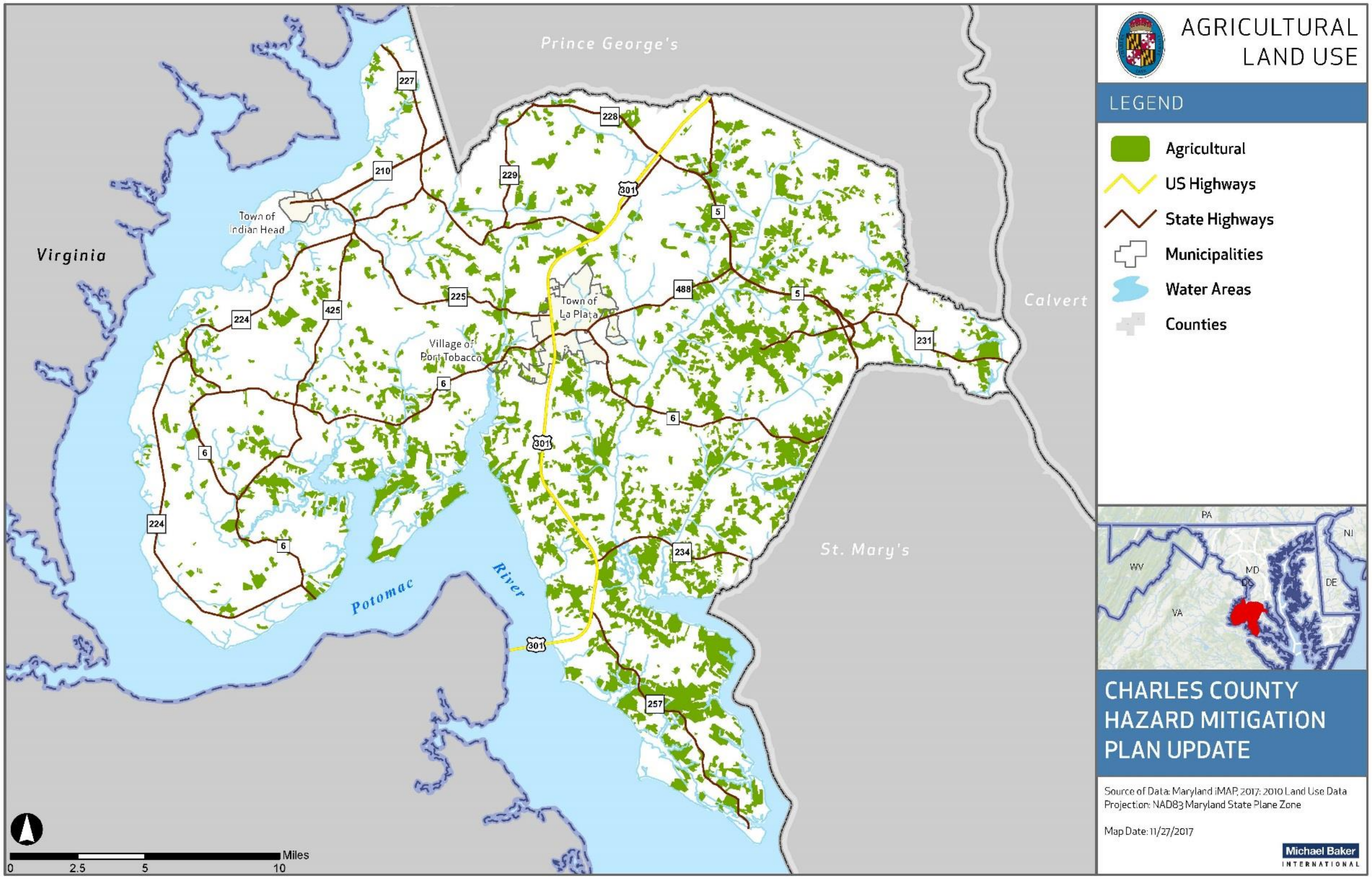
A **water management drought** is characterized as water deficiencies that exist due to failure of water management practices or facilities to bridge normal or abnormal dry periods and equalized water supply throughout the year.

A drought is a period of prolonged dryness that contributes to depletion of ground-water and surface-water yields. When droughts occur, they can have significant adverse consequences to:

- Public water supplies for human consumption
- Rural water supplies for livestock consumption and agricultural operations
- Water quality
- Natural soil water or irrigation water for agriculture
- Water for forests and for fighting forest fires
- Water for navigation and recreation.

Droughts are regional climatic events, so when these events occur in Charles County, impacts are felt across the entire county as well as areas outside county boundaries. The spatial extent for areas of impact can range from Southern Maryland to the entire mid-Atlantic region. Areas with extensive agricultural land uses can experience particularly significant impacts. As shown in Figure 3.3.1-1, agricultural land uses are dispersed throughout the entirety of Charles County, but are most heavily concentrated in the eastern and southeastern parts of the County.

Figure 3.3.1-1: Charles County Agricultural Land Use



Droughts can have varying effects, depending on the month in which they occur, as well as the severity, duration, and location of the event. Even short-term droughts can be devastating, especially in conjunction with extreme temperatures.

There are three main measures of drought severity: The Standard Precipitation Index, the Palmer Drought Severity Index, and the United States Drought Monitor Drought Severity Classification. Table 3.3.1-2 shows the drought severity levels based on these indices and describes the possible impacts of each level.

The Standardized Precipitation Index (SPI) is based on the probability of an observed precipitation deficit occurring over a given prior time-period. The assessment periods considered range from 1 to 36 months. The variable time scale allows the SPI to describe drought conditions important for a range of meteorological, agricultural, and hydrological applications. For example, soil moisture conditions respond to precipitation deficits that occur on a relatively brief time scale, whereas groundwater, stream flow, and reservoir storage respond to precipitation deficits arising over many months.

The Palmer Drought Severity Index (PDSI) was developed by Wayne Palmer in the 1960s and uses temperature and rainfall information to determine dryness. It has become the semi-official drought index. The PDSI is most effective in determining long term drought (several months) and is not as helpful with short-term forecasts (a matter of weeks). It uses a 0 as normal, and drought is shown in terms of minus numbers. For example, minus 2 is moderate drought, minus 3 is severe drought, and minus 4 is extreme drought.

The United States Drought Monitor (USDM) Drought Severity Classification is based on local reports from expert observers, the impact that drought has on the area, and a composite of five drought indicators, including both the SPI and the PDSI.

Table 3.3.1-2: Drought Severity Classifications (National Drought Mitigation Center, 2017)

DROUGHT SEVERITY	RETURN PERIOD (YEARS)	DESCRIPTION OF POSSIBLE IMPACTS	DROUGHT MONITORING INDICES		
			Standardized Precipitation Index (SPI)	Palmer Drought Severity Index (PDSI)	USDM Drought Category
Abnormally Dry	3 to 4	Going into drought: short-term dryness slowing growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.	-0.5 to -0.7	-1.0 to -1.9	D0
Moderate Drought	5 to 9	Some damage to crops or pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.	-0.8 to -1.2	-2.0 to -2.9	D1
Severe Drought	10 to 17	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.	-1.3 to -1.5	-3.0 to -3.9	D2

Table 3.3.1-2: Drought Severity Classifications (National Drought Mitigation Center, 2017)					
DROUGHT SEVERITY	RETURN PERIOD (YEARS)	DESCRIPTION OF POSSIBLE IMPACTS	DROUGHT MONITORING INDICES		
			Standardized Precipitation Index (SPI)	Palmer Drought Severity Index (PDSI)	USDM Drought Category
Extreme Drought	18 to 43	Major crop and pasture losses; extreme fire danger; widespread water shortages or restrictions.	-1.6 to -1.9	-4.0 to -4.9	D3
Exceptional Drought	44+	Exceptional and widespread crop and pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells creating water emergencies.	Less than -2.0	-5.0 or less	D4

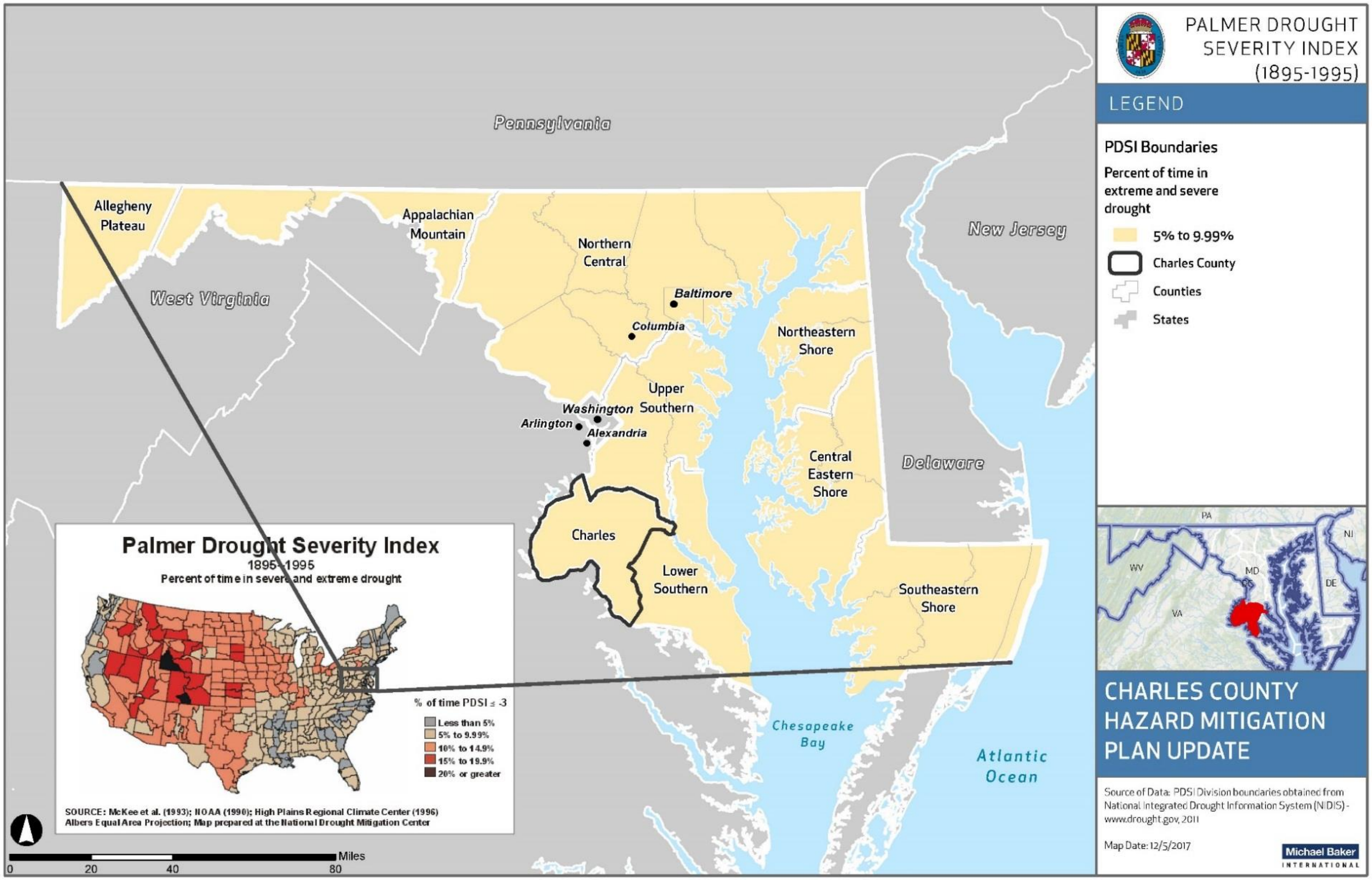
As shown in Figure 3.3.1-2, Charles County and the entirety of Maryland are located in an area where severe and extreme drought occurs 5% to 9.9% of the time according to the PDSI based on data from 1895 to 1995. This was the most current data available at the time of the HMP Update.

3.3.1.2 Past Occurrence

According to the National Drought Mitigation Center, significant damages to agriculture have occurred since reporting began in 1986. The most notable events occurred in 1986, 1999, 2002 and 2007. These events are significant due to the persistent dry conditions, exceptional and widespread crop and pasture losses; increased fire risk; and water restrictions. Summarized in Table 3.3.1-1 are drought events that have occurred since 1986 in Charles County.

Table 3.3.1-1: Drought Events in Charles County since 1986 (National Drought Mitigation Center, 2017)			
DATE	TYPE	CATEGORY IMPACTED	DAMAGE
January – October 1986	Drought	Agriculture	Agriculture products
January – December 1988	Drought	Environmental	Chesapeake Bay Oyster Harvest
August 1991	Drought	Other	Farming
August – September 1997	Drought	Agriculture/Environmental	Farming
September 1998	Drought	Agriculture	Agriculture products
May – August 1999	Drought	Agriculture, Environmental, Water/Energy, Other	Water restriction, farming, agricultural products, crop loss, Sod farming,
March – September 2002	Drought	Agriculture, Fire, Other, Environmental	Farming, livestock, wildfires
September – October 2005	Drought	Agriculture, Fire, Environment	Agriculture products, farming
January – December 2007	Drought	Agriculture, Fire Environmental, Water/Energy, Other	Wildfires, agricultural products, livestock, farming
June – August 2010	Drought	Agriculture, Other, Fire	Agricultural products, farming, fire danger

Figure 3.3.1-2: Palmer Drought Severity Index, 1895-1995, Percent of time in Severe and Extreme Drought



According to the National Oceanic and Atmospheric Administration's (NOAA) Storm Events Database, there have been 12 reported drought events in Charles County since 1950.

Table 3.3.1-1: Drought Events in Charles County since 1950 (NOAA, 2017)

DATES	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
August 1998	0	0	$0	$0.00
October 1998	0	0	$0	$0.00
November 1998	0	0	$0	$1,670,000
December 1998	0	0	$0	$0
May 1999	0	0	$0	$0
June 1999	0	0	$0	$0
July 1999	0	0	$0	$0
August 1999	0	0	$0	$0
September 1999	0	0	$0	$0
July 2007	0	0	$0	$0
August 2007	0	0	$0	$0
October 2007	0	0	$0	$0
Total	**0**	**0**	**$0**	**$1,670,000**

The drought that occurred in 1998 had the largest impact on Charles County, causing $1,670,000 in crop damage. After much of the state had experienced drought conditions for several months in a row, only 1.0 inch of rain fell in Charles County in November 1998. Water levels and reserves were greatly affected by the persistent drought. By November 20th, 80% of topsoil moisture across the state was rated short or very short. Statewide, this drought contributed $40 million in damage to the fall harvest. The lack of precipitation also had a negative impact on winter crops such as wheat, barley, and rye, and reports indicated that winter grain crops were only half as tall as they should have been at the end of the month. Some farmers even decided to not plant winter crops that year due to the lack of moisture. The drought also contributed to a six-fold increase in the amount of brush fires seen across the state in November 1998, with officials reporting 173 fires burning a total of 490 acres. From the beginning of August 1998 to the end of November 1998, the Forest Service recorded 303 fires statewide (NOAA, 2017).

Indemnity payments for losses suffered from drought are also an indicator of past drought events and their impacts, specifically to agriculture. Table 3.3.1-5 indicates that there was a total of over $5,000,000 in indemnity payments for losses suffered due to drought in Charles County between 1989 and 2014. The years with the greatest amount of indemnity payments were 2007, 2012, 2010, and 1999.

3.3.1.3 Future Occurrence

It is difficult to forecast the severity and frequency of future drought events in Charles County. Based on data from 1895 to 1995, Charles County has an annual probability of severe or extreme drought of 5% to 9.9% (see Figure 3.3.1-2). This is equivalent to a PDSI value less than or equal to -3.

Therefore, the probability of drought impacting Charles County is considered *unlikely* (1 out of 4) as defined by the Risk Factor Methodology probability criteria.

Overall, the County feels that current water needs are being met even during times of drought. However, serious hydrological droughts or supply deficiencies could occur in the future, especially during periods of drought, as continued growth in population, increased demand for water from industry, and the effects of land development (which tends to reduce the water table) increase demand for water.

Table 3.3.1-5: Indemnity Payments for Losses Suffered to Drought in Charles County (USDA Risk Management Agency, 2014)

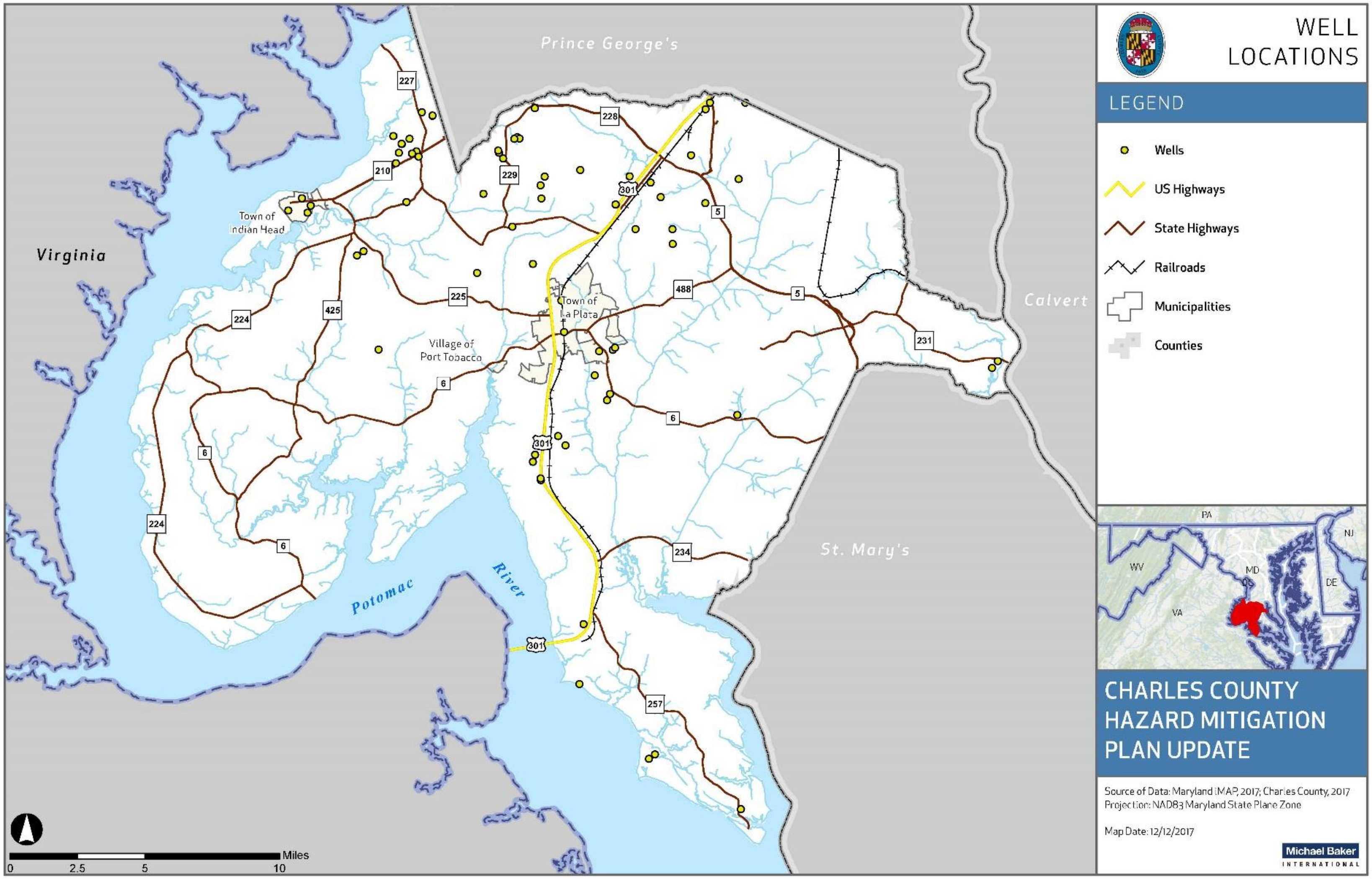
YEAR	INDEMNITY PAYMENTS
1989	$0
1990	$16,523
1991	$111,762
1992	$1,796
1993	$73,027
1994	$3,293
1995	$26,647
1996	$0
1997	$48,118
1998	$140,071
1999	$368,535
2000	$0
2001	$19,928
2002	$740,153
2003	$0
2004	$0
2005	$213,489
2006	$74,555
2007	$1,049,171
2008	$338,415
2009	$105,048
2010	$761,512
2011	$157,965
2012	$997,339
2013	$16,990
2014	$114,105
Total	**$5,378,442**

3.3.1.4 Vulnerability Assessment

There is no commonly accepted approach for assessing risk associated with droughts given the varying types and indices. Drought risk is based on a combination of the frequency, severity, and spatial extent (the physical nature of drought) and the degree to which a population or activity is vulnerable to the effects of drought. The degree of Charles County's vulnerability to drought depends on the environmental and social characteristics of the region and is measured by its ability to anticipate, cope with, resist, and recover from drought.

Drought typically does not have a direct impact on critical facilities or structures; however, the indirect impacts of drought can. The combination of drought and lowering groundwater levels also has the potential to cut deeper stream channels, which creates higher stream banks and separates streams from their floodplains. This causes downcutting of stream banks, increased erosion, and higher sediment loads in affected streams. These impacts can result in the collapse of structures along streams, as the banks are undercut and eroded, as well as in the loss of agricultural land and archaeological sites. A worst-case scenario event as a result of a drought could involve mudslides due to heavy rains when a drought breaks, which could result

Figure 3.3.1-3: Well Locations within Charles County



in damage to structures (recent and historic) as well as archaeological sites.

Additionally, possible impacts to critical facilities include the loss of critical function due to low water supplies. Most of Maryland relies on ground water as its source of water, coming from confined and unconfined aquifers, and Southern Maryland relies exclusively on ground water. The locations of wells throughout Charles County are shown in Figure 3.3.1-1. Severe droughts can negatively affect drinking water supplies, and if a public water system were affected and outside water was required to be shipped in, the losses could total into the millions of dollars. Private springs and wells could also potentially dry up, and possible losses to infrastructure include the loss of potable water. Should a drought affect the water available for public water systems or individual wells, the availability of clean drinking water could be compromised. This situation would require emergency actions and could possibly overwhelm local governments and financial resources.

Impacts to vegetation and wildlife can include death from dehydration as well as spread of invasive species or disease because of stressed conditions. However, drought is a natural part of the environment in Maryland and native species are likely to be adapted to surviving periodic drought conditions. It is unlikely that drought would jeopardize the existence of rare species or vegetative communities. Environmental impacts are more likely to occur at the interface of the human and natural world. Wind and water erosion can alter the visual landscape and dust can damage property. Water-based recreational resources can also be affected by drought conditions. Indirect impacts from drought arise from wildfire, which may have additional effects on the landscape and sensitive resources such as historic or archaeological sites.

The loss of crops or livestock due to drought can have far-reaching economic effects. Agriculture is the first resource to be impacted by a drought and is the asset that is most vulnerable to the impacts of this hazard in Charles County. According to the most recent Census of Agriculture, there were 382 farms in Charles County totaling 46,659 acres. The market value of products sold by these farms in 2012 was $11,946,000, 90% of which was in crop sales (as opposed to livestock). Table 3.3.1-6 displays the top five agricultural commodity groups by sales in Charles County and illustrates that most of sales come from grains, oilseeds, dry beans, and dry peas (USDA, 2012).

Table 3.3.1-6: Top five agricultural commodity groups by sales in Charles County (USDA, 2012)

COMMODITY GROUP	VALUE OF SALES
Grains, oilseeds, dry beans, and dry peas	$7,596,000
Nursery, greenhouse, floriculture, and sod	$1,526,000
Vegetables, melons, potatoes, and sweet potatoes	$942,000
Cattle and calves	$508,000
Fruits, tree nuts, and berries	$244,000

3.3.1.5 Jurisdictional Differences

Due to the regional nature of drought, all jurisdictions within Charles County are expected to be impacted equally by drought conditions. However, in the event of a drought, agricultural areas of the County may be the first areas to experience its impacts.

3.3.1.6 Land Use and Development Trends

Society's vulnerability to drought is affected by population growth and shifts, urbanization, demographic characteristics, technology, water use trends, government policy, social behavior, and environmental awareness. These factors are continually changing, and society's vulnerability to drought may rise or fall in response to these changes. For example, increasing and shifting populations increase pressure on the supply of water and other natural resources, since more people need more water.

According to the population estimates by the U.S. Census Bureau, Maryland's 2016 residential population was over 6 million people, having grown 4.2% since the 2010 Census. Charles County's residential population has grown at a rate faster than that of the state as a whole (5.3% between 2010 and 2016). According to the Maryland Department of Planning, the population of Charles County is projected to grow to over 222,000 by 2040, which is over a 40% increase compared to the 2016 population of 154,357.

Future development's greatest impact on the drought hazard would possibly be to ground water resources. New water and sewer systems or significant well and septic sites could use up more of the water available, particularly during periods of drought. Public water systems are monitored, but individual wells and septic systems are not as strictly regulated. Additionally, the effects of land development tend to reduce the water table. Therefore, future development could have an impact on drought vulnerabilities.

3.3.2 Earth Disturbance

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING (PRIORITY)
Natural	2	1	3	3	1	**1.9**
LOW RISK (Less than 2.0)						

Earthquake

An earthquake is the motion or trembling of the ground produced by sudden displacement of massive rocks called plates, usually within the upper 10-20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns. The impact of earthquakes can extend up to hundreds of thousands of square miles. Earthquakes are also known to cause fatal loss and injury, including substantial property damages of tens of billions of dollars, while disrupting the social and economic functioning of the affected area. Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to the ground shaking, which is dependent upon amplitude and duration of the earthquake (FEMA, 1997). There are many faults hidden underground that are large enough to generate damaging earthquakes, but are also too small to extend from earthquake depths all the way up to ground level where they can be identified as faults. Accordingly, the best guide for earthquake hazards is often the earthquakes themselves. Future earthquakes are most likely to occur in the same general regions that have experienced past occurrences.

Landslide

A landslide is the downward and outward movement of earth materials reacting under the force of gravity. As such, “landslide” can be used to describe a number of different types of events displaying different movement characteristics and involving different materials. Rockslides, rock falls, mudflows, mudslides, debris flows, and debris avalanches are all types of landslide events that involve different materials moving in a different manner. Landslides typically occur when some factor (e.g., increased water content or change in load) causes the force of gravity to outweigh the forces working to hold material in place, resulting in the downslope movement of the subject material. Several natural and human factors may contribute to or influence landslides. These factors include topography, geology, precipitation, steepness of cut and fill slopes, and cut-slope stability.

Mudslides, also referred to as mudflows, lahars, or debris avalanches, are quick moving rivers of earth, rock, and other debris flooded with water. Mudslides develop when water rapidly accumulates in the ground, typically from heavy rainfall or rapid snowmelt, creating a river of “slurry” or mud. A slurry can travel several miles from its original location, and increase in volume as it carries materials such as trees and cars. Slurries are especially dangerous due to their fast movement down slopes, and little warning when at avalanche speeds. Once the mudslide reaches flatter ground, the mudflow will spread out over a broad area where it can gather in thick deposits. In the United States alone, landslides have been known to cause up to $3.5 billion in damages, and nearly 25 to 50 deaths annually (USGS, 2004).

Subsidence

Subsidence is defined as the downward movement of surface material with little or no horizontal movement. Subsidence can occur naturally due to the physical and chemical weathering of certain types of bedrock or can be human-induced due to underground mining or excessive pumping of groundwater. Regardless of the reason for occurrence, the overall effect of a subsidence event is the same. That is, the development and eventual failure of a sinkhole, which can cause significant structural damage if buildings and/or infrastructure are present.

A sinkhole is a circular depression, typically funnel-shaped, caused by the undermining or collapse of the land's surface. Sinkholes often are a result of groundwater enlarging cavities in underlying karst or soluble bedrock. Karst is a type of topography formed from the dissolution of soluble carbonate rock, such as limestone, dolomite, gypsum and is characterized by sinkholes, caves, and open-channel groundwater flow.

While, sinkholes may be depressions formed in karst areas, not every depression or hole naturally occurring in the ground is a sinkhole. Depressions may also be a result of decayed tree stumps, stormwater runoff, leaking underground pipes, or dilapidated underground structures, such as septic tanks (Maryland Geologic Survey, 2018). Genuine sinkholes do not form in areas of hard crystalline rock-like structures, which are present in central and western Maryland. Neither do they form in the unconsolidated sediments of Maryland's Coastal Plain, the area approximately east of I-95 (Maryland Geologic Survey, 2018).

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

3.3.2.1 Location, Extent, and Range of Magnitude

Earthquake

Earthquake Mechanics

Regardless of the source of the earthquake, the associated energy travels in waves radiating outward from the point of release. When these waves travel along the surface, the ground shakes and rolls, fractures form, and water waves may be generated. Earthquakes generally last a matter of seconds, but the waves may travel for long distances and cause damage well after the initial shaking at the point of origin has subsided.

Breaks in the crust associated with seismic activity are known as "faults" and are classified as either active or inactive. Faults may be expressed on the surface by sharp cliffs or scarps or may be buried below surface deposits.

"Foreshocks," minor releases of pressure or slippage, may occur months or minutes before the actual onset of the earthquake. "Aftershocks," which range from minor to major, may occur for months after the main earthquake. In some cases, strong aftershocks may cause significant additional damage, especially if the initial earthquake impacted emergency management and response functions or weakened structures.

Factors Contributing to Damage

The damage associated with each earthquake is subject to four primary variables:

- The nature of the seismic activity
- The composition of the underlying geology and soils
- The level and quality of development of the area struck by the earthquake
- The time of day

Seismic Activity: The properties of earthquakes vary greatly from event to event. Some seismic activity is localized (a small point of energy release), while other activity is widespread (e.g., a major fault letting loose all at once). Earthquakes can be very brief (only a few seconds) or last for a minute or more. The depth of release and type of seismic waves generated also play roles in the nature and location of damage; shallow quakes will hit the area close to the epicenter harder, but tend to be felt across a smaller region than deep earthquakes.

Geology and Soils: The surface geology and soils of an area influence the propagation (conduction) of seismic waves and how strongly the energy is felt. Generally, stable areas (e.g., solid bedrock) experience less destructive shaking than unstable areas (e.g., fill soils). The location of a community or even individual buildings plays a strong role in the nature and extent of damage from an event.

Development: An earthquake in a densely populated area which results in many deaths and considerable damage may have the same magnitude as a shock in a remote area that has no direct impact. Large magnitude earthquakes that occur beneath the oceans may not even be felt by humans.

Time of Day: The time of day of an event controls the distribution of the population of an affected area. During the week days more of the population will be affected because communities will transition between work, school, or home. The relative seismic vulnerability of each location can strongly influence the loss of life and injury resulting from an event.

Types of Damage

While damage can occur by movement at the fault, most damage from earthquake events is the result of shaking. Shaking also produces several phenomena that can generate additional damage:

- Ground displacement
- Landslides and avalanches
- Liquefaction and subsidence
- Seiches

Shaking: In minor events, objects fall from shelves and dishes are rattled. In major events, large structures may be torn apart by the forces of the seismic waves. Structural damage is generally limited to older structures that are poorly maintained, constructed, or designed in all but the largest quakes. Un-reinforced masonry buildings and wood frame homes that are not anchored to their foundations are typical victims.

Loose or poorly secured objects also pose a significant hazard when they are loosened or dropped by shaking. These “non-structural falling hazard” objects include bookcases, heavy wall hangings, and building facades. Home water heaters pose a special risk due to their tendency to start fires when they topple over and rupture gas lines. Crumbling chimneys may also be responsible for injuries and property damage.

Dam and bridge failures are significant risks during stronger earthquake events, and due to the consequences of such failures, may result in considerable property damage and loss of life. In areas of severe seismic shaking hazard, Intensity VII or higher can be experienced even on solid bedrock. In these areas, older buildings especially are at significant risk.

Ground Displacement: Often, the most dramatic evidence of an earthquake results from displacement of the ground along a fault line.

Landslides and Avalanches: Even small earthquake events can cause landslides. Rock falls are common as unstable material on steep slopes is shaken loose, but significant landslides or even debris flows can be generated if conditions are ripe. Roads may be blocked by landslide activity, hampering response and recovery operations. Avalanches are possible when the snowpack is sufficient.

Liquefaction and Subsidence: Soils may liquefy and/or subside when impacted by the seismic waves. Fill and previously saturated soils are especially at risk. The failure of the soils can lead to possibly widespread structural damage. The oscillation and failure of the soils may result in increased water flow and/or failure of wells as the subsurface flows are disrupted and sometimes permanently altered. Increased flows may be dramatic, resulting in geyser-like water spouts and/or flash floods. Similarly, septic systems may be damaged creating both inconvenience and health concerns.

Seiches: Seismic waves may rock an enclosed body of water (e.g., lake or reservoir), creating an oscillating wave referred to as a “seiche.” Although, these are not a common cause of damage, seiches in past Idaho earthquakes generated forceful waves along the states large lakes, similar to those of a tsunami (tidal wave). A seiche would be a hazard to shoreline development, fragile ecosystems, and pose a significant threat to dam-created reservoirs. A seiche could either overtop or damage a dam leading to downstream flash flooding.

Figure 3.3.2-1 depicts the location and extent of where earthquake events have occurred in relation to Charles County from 1973 until 2017. Although, no earthquake incidents have been recorded in Charles County since 1960, the closest earthquake event occurred in Prince George’s County. The earthquake in Prince George’s County occurred on May 23, 1986 and was a 2.5 on the Richter Scale. Earthquake magnitude is often measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake. Table 3.3.2-1 summarizes Richter Scale magnitudes as they relate to the spatial extent of impacted areas.

Table 3.3.2-1: Richter scale magnitudes and associated earthquake size effects.

RICHTER MAGNITUDES	EARTHQUAKE EFFECTS
Less than 3.5	Generally, not felt but recorded.
3.5-5.4	Often felt, but rarely causes damage.
5.4- 6.0	At most, slight damage to well-designed buildings; can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive up to about 100 kilometers from epicenter.
7.0-7.9	Major earthquake; can cause serious damage over large areas.
8.0 or greater	Great earthquake; can cause serious damage in areas several hundred kilometers across.

The Richter scale does not give any indication of the impact or damage of an earthquake, although it can be inferred that higher magnitude events cause more damage. Instead, the impact of an earthquake event is measured in terms of earthquake intensity, usually measured using the Modified Mercalli Intensity Scale, shown in Table 3.3.2-2. Based on historical data of earthquakes with a recorded Intensity, little damage is expected from earthquake events. No injury or severe damage from earthquake events has been reported in Charles County.

Table 3.3.2-2: Modified Mercalli Intensity Scale with Associated Impacts.

SCALE	INTENSITY	DESCRIPTION OF EFFECTS	CORRESPONDING RICHTER SCALE MAGNITUDE
I	**Instrumental**	Usually detected only on seismographs.	<4.2
II	**Feeble**	Felt only by a few persons at rest, especially on upper floors of buildings.	
III	**Slight**	Felt quite noticeably indoors, especially on upper floors. Most people do not recognize it as an earthquake (i.e. a truck rumbling).	
IV	**Moderate**	Can be felt by people walking; dishes, windows, and doors are disturbed.	
V	**Slightly Strong**	Sleepers are awoken; unstable objects are overturned.	<4.8
VI	**Strong**	Trees sway; suspended objects swing; objects fall off shelves; damage is slight.	<5.4

Table 3.3.2-2: Modified Mercalli Intensity Scale with Associated Impacts.

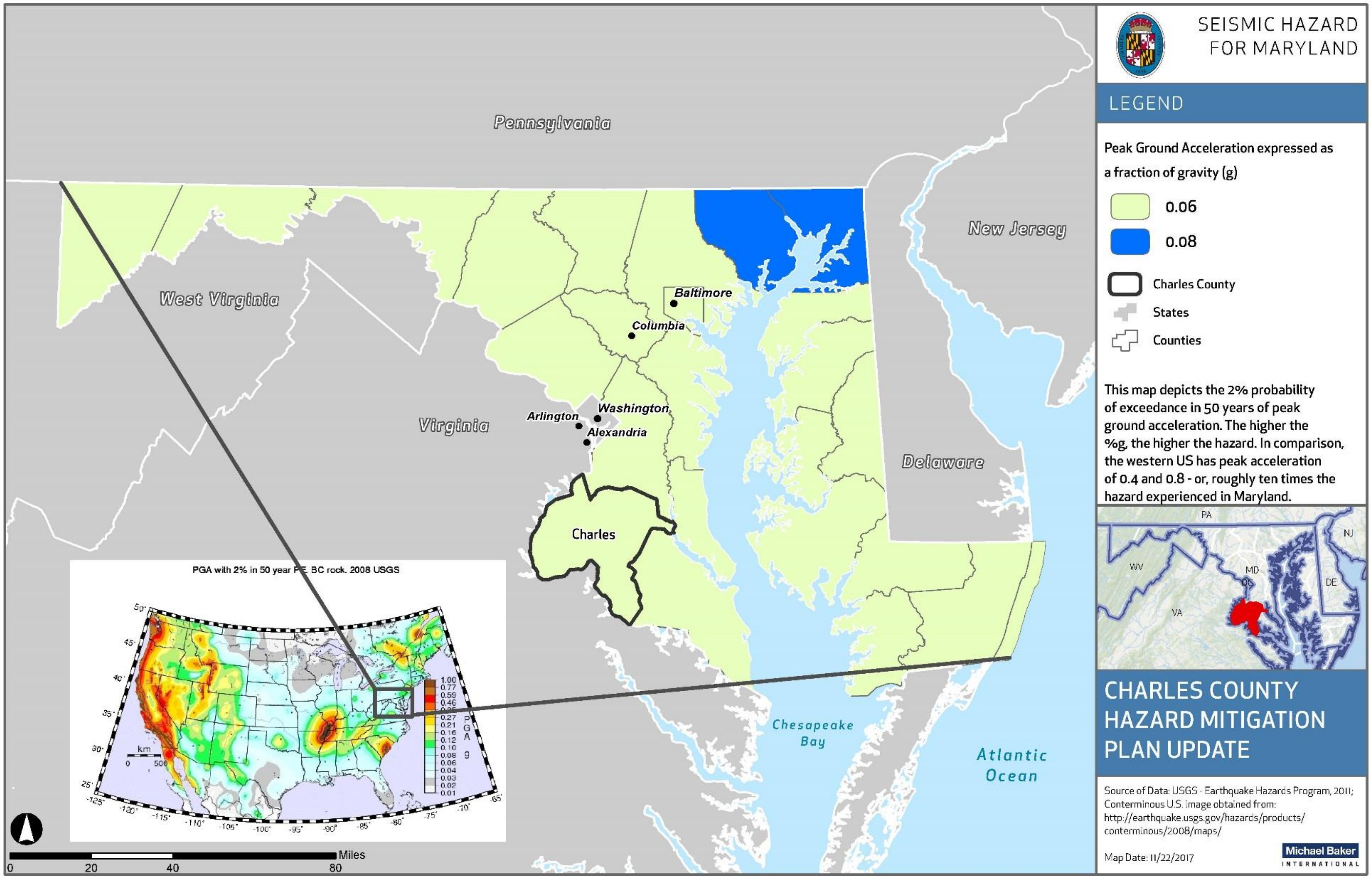
SCALE	INTENSITY	DESCRIPTION OF EFFECTS	CORRESPONDING RICHTER SCALE MAGNITUDE
VII	Very Strong	Damage is negligible in buildings of good design and construction, slight to moderate in well-built ordinary structures, and considerable in poorly built or badly designed structures; some chimneys are broken. Historic structures could be damaged.	<6.1
VIII	Destructive	Damage is slight in specially designed structures; considerable in ordinary, substantial buildings. Moving cars become uncontrollable; masonry fractures, poorly constructed buildings damaged. Historic structures likely to be damaged or potentially destroyed.	<6.9
IX	Ruinous	Some houses collapse, ground cracks, pipes break open; damage is considerable in specially designed structures; buildings are shifted off foundations. Historic structures likely to be damaged or potentially destroyed.	
X	Disastrous	Some well-built wooden structures are destroyed; most masonry and frame structures are destroyed along with foundations. Ground cracks profusely; liquefaction and landslides widespread. Historic structures very likely to be damaged or potentially destroyed.	<7.3
XI	Very Disastrous	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed. Historic structures very likely to be damaged or destroyed.	<8.1
XII	Catastrophic	Destruction; trees fall; lines of sight and level are distorted; ground rises and falls in waves; objects are thrown upward into the air.	>8.1

Since the worst earthquake recorded in Maryland had a magnitude of 3.7, a worst-case scenario for this hazard would be if an earthquake of similar magnitude occurred in Charles County or near the border in an adjacent county, causing mild damage in populated areas. Structural damage would not be expected in this scenario for most buildings, but blighted structures or those in a state of disrepair might experience further structural damage.

Environmental impacts of earthquakes can be numerous, widespread, and devastating, particularly if indirect impacts like economic impacts are considered. Earthquakes are known for causing induced tsunamis, flooding, landslides, avalanches, poor water quality, damage to vegetation, and breakage in sewage or toxic material containments.

Earthquake events in Maryland, including Charles County are mild. When events occur, they impact very small areas less than 100 kilometers in diameter. Figure 3.3.2-1 shows the earthquake hazard in Maryland and Charles County, expressed as the two-percent probability of exceedance in 50 years of peak ground acceleration (g). This map was digitized from the 2014 National Seismic Hazard report. Charles County lies in the 0.06 zone, indicating that the hazard is minimal.

Figure 3.3.2-1: Approximate USGS seismic hazard for Maryland and Charles County



Landslide

Rockfalls and other slope failure can occur in areas of Charles County with moderate to steep slopes. However, the elevation and land relief of Charles County is approximately 235 feet and has a relatively low slope gradient (Maryland Geological Survey, 2018). Figure 3.3.2-2 depicts variances in slope grade for Charles County, gradients with higher percentages of slope change are more likely to have a landslide incidence (areas in red and orange represent have slopes of 15% of greater, indicating vulnerability to landslide events).

Many slope failures are associated with precipitation events – periods of sustained above-average precipitation, specific rainstorms, or snowmelt events. Areas experiencing erosion, decline in vegetation cover, and earthquakes are also susceptible to landslides. Human activities that contribute to slope failure include altering the natural slope gradient, increasing soil water content, and removing vegetation cover.

The Marlboro Clay formation is a geologic outcrop originally discovered in exposures near Upper Marlboro in Prince George's County and is of great significance due to its high rate of instability (Maryland Geologic Survey, 2018). The Marlboro Clay is a continuous layer throughout nearly the whole of Southern Maryland. Due to its natural thinness and readily covered slumping of overlying sediments, the Marlboro is poorly exposed. The narrow outcrop belt enters the area near Palmers Corner in Prince Georges County and drifts southwest for roughly 20 miles to the vicinity of Rison, an unincorporated community in Charles County. Deposits of the clay are present along the creeks of the Mattawoman and the Piscataway, Mason Springs, and the valleys of the Piscataway (Maryland Geologic Survey, 2018).

In Maryland's Coastal Plain province, the Marlboro Clay is one of the geologic formations highly susceptible to slope failure (Maryland Geologic Survey, 2018). Other formations highly susceptible to slope failure include clays of the Potomac and the St. Mary's Formation located southeast of Charles County. Both slumps and earthflows can occur in the Marlboro Clay. Slope failures are particularly numerous in southwestern and east-central Prince Georges County, adjacent to Charles County. As overlying permeable sediment becomes heavily saturated with infiltrating precipitation, the frictional resistance lowers along the contact with the low permeability Marlboro Clay producing a slide surface which could potentially lead to slope failure.

Figure 3.3.2-3 shows a map of moderate and low areas of landslide susceptibility as defined by the USGS throughout Charles County. These areas were delineated based on where landslides have occurred in the past and where they may occur in the future. Moderate susceptibility is visible in the northwestern region of Charles County, just south of the Town of Indian Head, to the northwest of Bennsville, and along the border of Accokeek. The remaining jurisdictions are in areas of low landslide susceptibility.

Figure 3.3.2-2: Steep slope locations in Charles County

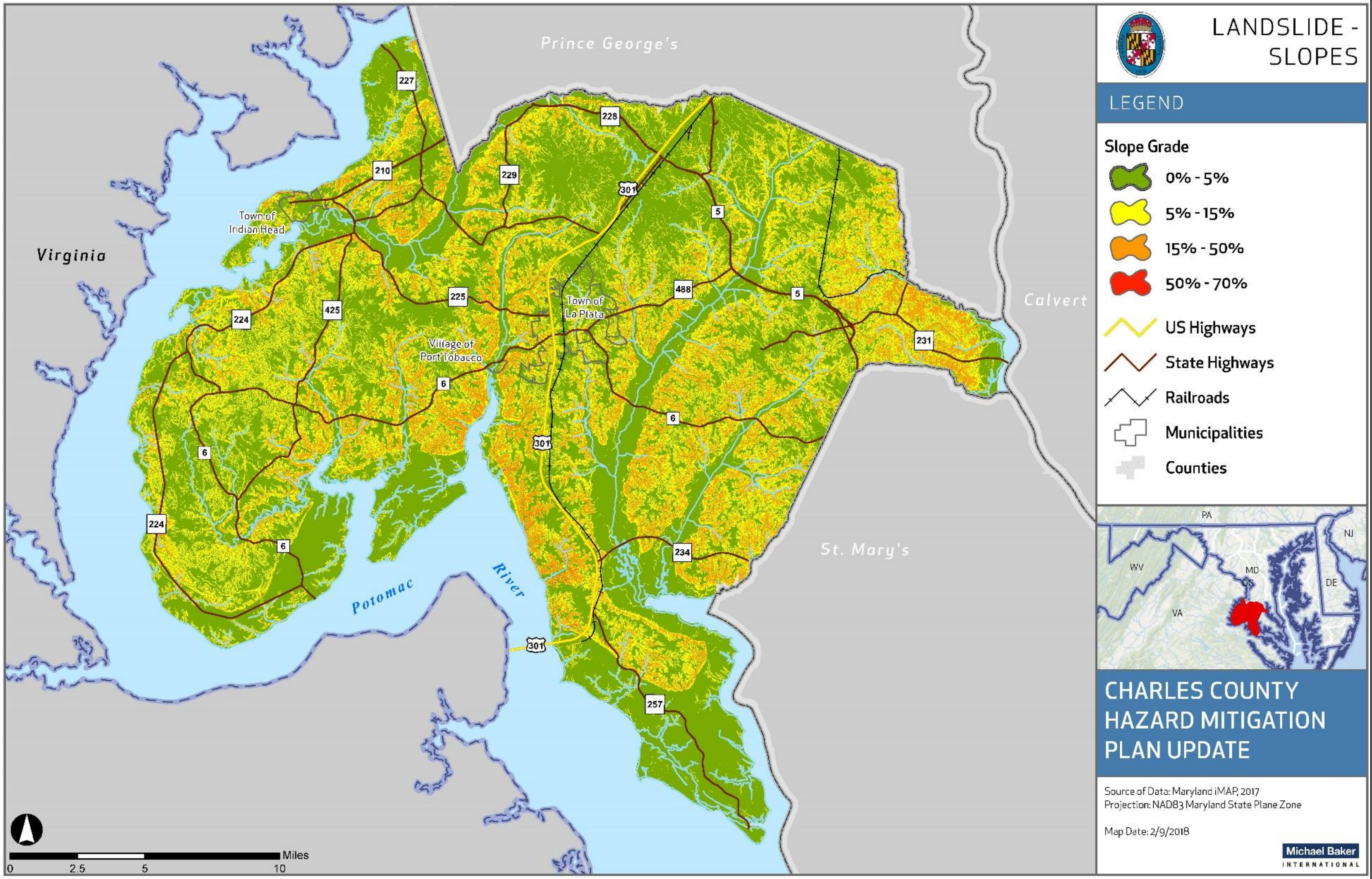
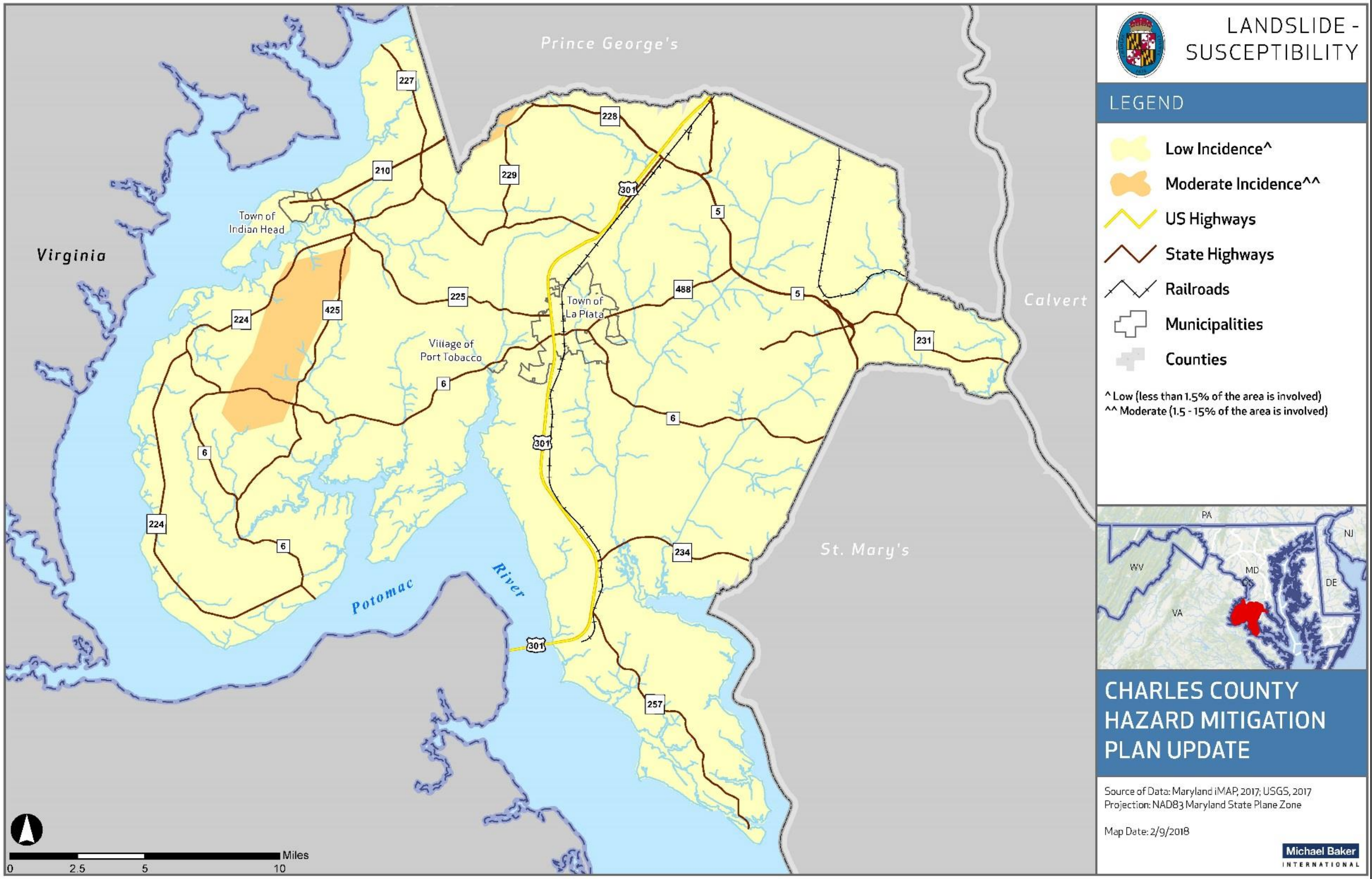


Figure 3.3.2-3: Landslide Susceptibility in Charles County



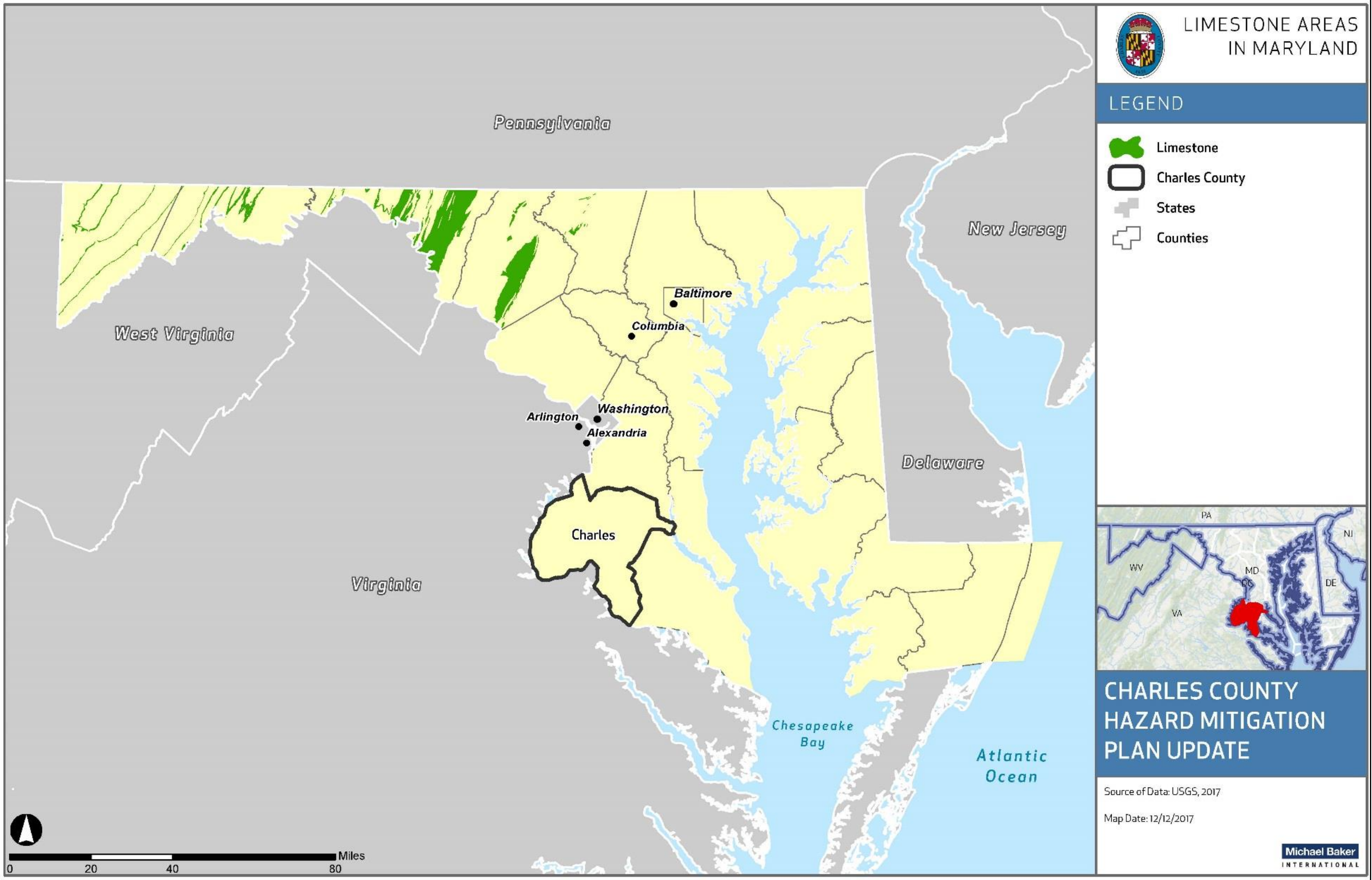
Subsidence

Subsidence is the gradual or sudden caving in or sinking of land. There are two common causes of subsidence in Maryland: mining activity and dissolution of carbonate rock such as limestone or dolomite. In some parts of Maryland, sinkholes are found in areas underlain by carbonate bedrock, however Charles County is not underlain by carbonate bedrock, but still has instances of subsidence related to possible mining activity and heavy rain. Figure 3.3.2-4 depicts the location of limestone through Maryland. Mining also occurs throughout Charles County, but activities are predominantly limited to surface mining rather than underground mining.

The risk of subsidence incidents is not consistent throughout the state of Maryland, and is more likely to occur in areas where karst or carbonate rock are more prominent. Karst topography in Maryland is present in Allegany, Baltimore, Washington, Carroll, and Frederick Counties. Despite the lack of karst topography in Charles County, subsidence incidents have occurred throughout the Charles County region. These incidences have resulted in minor sinkholes due to major flooding.

Sinkholes occur in many shapes, from steep-walled holes to bowl or cone shaped depressions. Sinkholes are dramatic because the land generally stays intact for a while until the underground spaces get too big. Sinkholes can vary in size, from a few feet to hundreds of acres, and from less than 1 to more than 100 feet deep. If there is not enough support for the land above the spaces, then a sudden collapse of the land surface can occur. Under natural conditions, sinkholes form slowly and expand gradually. However, human activities such as dredging, constructing reservoirs, diverting surface water, and pumping groundwater can accelerate the rate of sinkhole expansions, resulting in the abrupt formation of collapsed sinkholes.

Figure 3.3.2-4: Limestone Areas Susceptible to Subsidence



3.3.2.2 Past Occurrence

Earthquake

Central Virginia, Southwestern Virginia, and the Atlantic seaboard north of Wilmington, Delaware has experienced significantly more seismic activity than Maryland (Maryland Geologic Survey, 2018). However, several earthquakes that have occurred in adjacent states have been felt in Maryland. This makes the likelihood of feeling an earthquake that occurred outside of Maryland more likely than one occurring within the state. On April 22, 1984 an earthquake of 4.1 on the Richter Scale, with an intensity of V to VI, occurred roughly 12 miles south of Lancaster, Pennsylvania (Maryland Geologic Survey, 2018). Effects could be felt throughout the northeastern region of Maryland. Impacts were mild, with an intensity of V effects, such as damaged windows, fallen hanging pictures, and shaking vehicles (Maryland Geologic Survey, 2018).

Based on available data, no earthquake epicenters have occurred south of Annapolis since April 25, 1758, and there are currently no known recordings of earthquakes in Charles County. However, in 2011 an earthquake epicenter with a magnitude of 5.8 occurred near Mineral, Virginia, roughly 80 miles from Charles County. Effects included slight damage, swaying trees, suspended objects swinging, and objects falling off shelves (Maryland Geologic Survey, 2018).

Figure 3.3.2-3 shows this earthquake as well as all other recorded historic earthquake events in Charles between 1973 and 2017. This was the most current earthquake data available when updating this HMP. No damage in Charles County have been reported from any earthquakes events, and most earthquakes in the region have occurred southwest of Charles County.

Figure 3.3.2-5: Earthquake Events and Proximity to Charles County, Maryland (1973-2017)

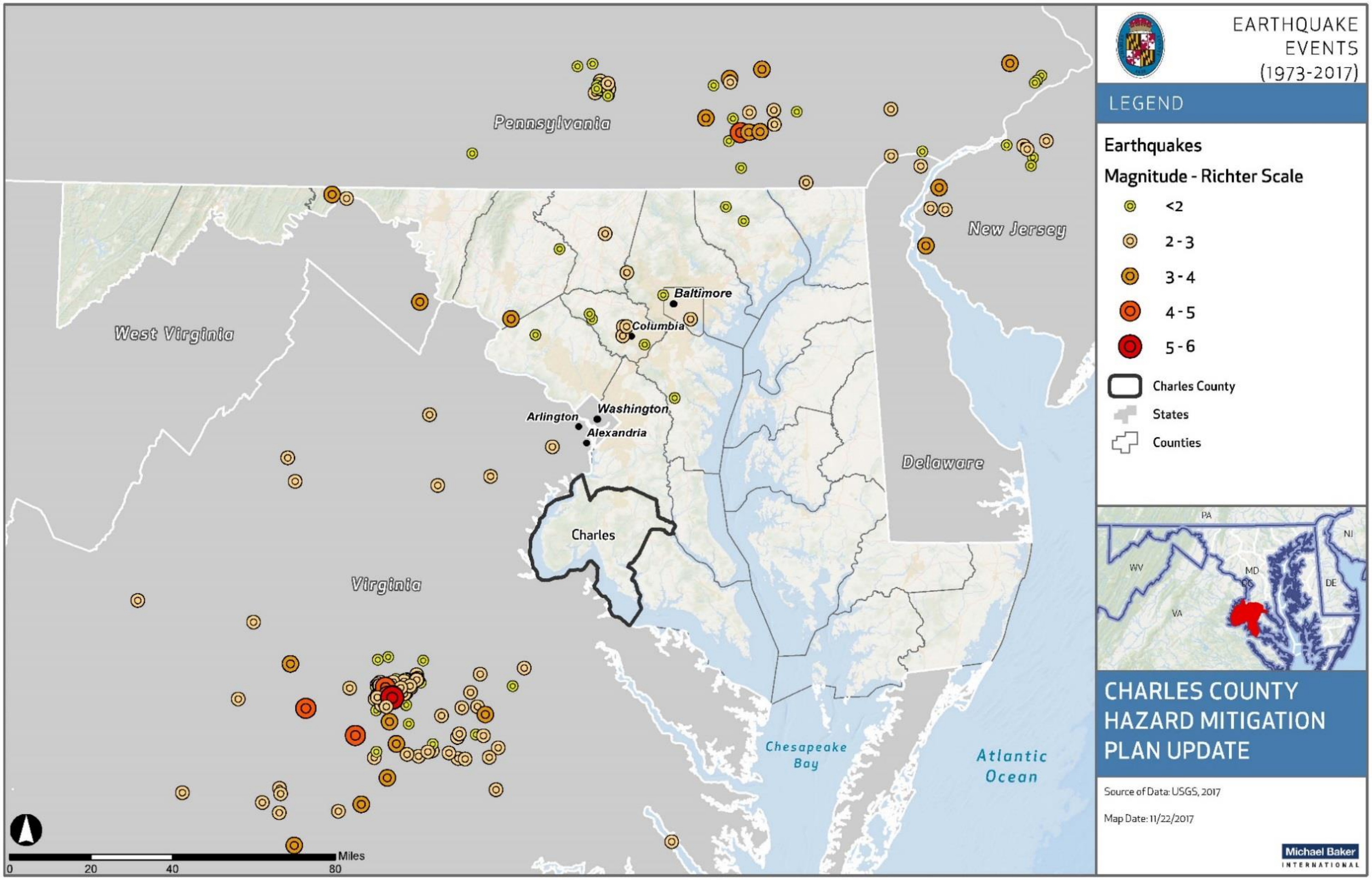


Table 3.3.2-3: Earthquake chronology of Maryland, 1939-2017 (USGS, 2017)				
DATE	EPICENTER		GENERAL LOCATION	MAGNITUDE
11/26/1939	39.5	-76.6	Phoenix	(3.5, 3.7)
9/7/1962	39.7	-78.2	Hancock	-3.3
4/26/1978	39.7	-78.24	Hancock	3.1
5/23/1986	38.69	-77.04	Accoceek - Piscataway	2.5
1/13/1990	39.36	-76.8	Randallstown (V), Eldersburg (IV), Ellicott City (IV), Granite (IV), Owings Mills (III)	2.6 2.5
4/4/1990	39.35	-76.78	Granite - Randallstown - Baltimore	1.7
9/28/1991	39.36	-76.83	Granite - Randallstown	2.4
3/10/1993	39.2	-76.8	Columbia (IV) - Ellicott City (II) - Fulton (II)	2.5
3/12/1993	39.19	-76.87	Columbia - Allview Estates	2
3/15/1993	39.19	-76.87	Columbia - Allview Estates - Laurel	2.7
3/16/1993	39.19	-76.87	Columbia - Allview Estates	1.8
3/16/1993	39.19	-76.87	Columbia - Allview Estates	1.8
3/17/1993	39.19	-76.87	Columbia - Allview Estates	=/< 1.0
3/19/1993	39.19	-76.87	Columbia - Allview Estates	1
3/19/1993	39.19	-76.87	Columbia - Allview Estates	<1.0
3/21/1993	39.47	-76.3	Aberdeen - Bel Air	1.5
3/22/1993	39.19	-76.86	Columbia - Allview Estates	about 0.0
3/26/1993	39.28	-76.82	Ellicott City near jct US40 & 29	<1.5 (est.)
4/4/1993	39.19	-76.87	Columbia - Allview Estates	1.5
4/4/1993	39.19	-76.87	Columbia - Allview Estates	1.5
4/8/1993	39.19	-76.87	Columbia - Allview Estates	1-1.5
7/9/1993	39.19	-76.87	Columbia - Allview Estates	1.9
7/12/1993	39.19	-76.87	Columbia - Allview Estates	2.1
10/28/1993	39.25	-76.77	Ilchester - Ellicott City	2.1
10/28/1993	39.25	-76.77	Ilchester - Ellicott City	1.8
11/17/1993	39.19	-76.87	Columbia - Allview Estates	1.7 (est.)
11/27/1993	39.19	-76.87	Columbia - Allview Estates	<1.5 (est.)
11/27/1993	39.19	-76.87	Columbia - Allview Estates	about 1.5 (est.)
10/28/1994	39.1	-76.6	Glen Burnie - Pasadena -Gambrills - Millersville	2.7
8/2/1996	39.57	-76.08	Perryville	2.2
10/17/1996	39.7	-76.07	Rising Sun (epicenter may be in Pennsylvania)	2.2, 2.3
12/6/1996	39.19	-76.87	Columbia - Allview Estates	<1.5 (est.)
12/14/1996	39.19	-76.87	Columbia - Allview Estates	<1.5 (est.)

Table 3.3.2-3: Earthquake chronology of Maryland, 1939-2017 (USGS, 2017)				
DATE	EPICENTER		GENERAL LOCATION	MAGNITUDE
12/16/1996	39.25	-76.77	Ilchester - Ellicott City	about 1 (est.)
12/22/1996	39.19	-76.87	Columbia - Allview Estates	2.0, 2.3
12/18/2001	38.19	-76.84	Columbia nr US29-Md32	1.5-2.0 (est)
3/22/2002	38.19	-76.84	Columbia nr US29-Md32	1-2 (est.)
12/27/2008	40.114	-76.4	9 km (6 miles) W of Lancaster, PA.	3.4
7/1/2009	39.64	-75.48	Southwestern New Jersey	2.8
9/29/2009	39.607	-76.34	7 km (4 miles) NNE (15°) from Bel Air North, MD	1.6
7/16/2010	39.17	-77.25	Potomac-Shenandoah Region, MD	3.4
8/23/2011	37.936	-77.93	8 km (5 miles) SSW (195°) from Mineral, VA	5.8
10/30/2017	39.279	-77.051	Glenelg, Maryland	1.52
11/11/2017	39.261	-77.039	0.8 km (0.5 mi) ESE of Roxbury, Maryland	1.5

Landslide

Due to the large amounts of clay deposits and unstable ground for development, landslides occur more frequently throughout Southern Maryland. In recent years Maryland has experienced several costly landslides, including one on May 6, 2014 in the Fort Washington area of southwest Prince Georges County. Slope failure associated with heavy rain was responsible for the evacuation of 28 homes and a road collapse. Over the course of three days roughly 1,500 feet of hillside slid three feet toward a section of the street. The moving earth was also accompanied by several fallen trees and powerlines. The road cost roughly $15 million in repairs (WUSA9, 2014). Another landslide threatened at least five homes in 2011 near Indian Head (WUSA9, 2011a).

Landslide history is not documented as completely (if at all) as other hazards, primarily because landslides are not always seen. Beyond debris avalanches associated with significant rain and flooding activity, only minor landslides in the form of falling rock and/or mud slides have occurred in Charles County to date. Minor landslides typically are incidents that have been in remote locations and have resulted in damages isolated to those regions.

There is no central database of landslide events in Charles County, and it does not appear that records of major landslides for the County exist. However, since landslides often occur during periods of heavy rain or snowmelt, flooding, and coastal flooding it is possible to examine past occurrences of heavy rain, snow, or flood events. At least 55 of these events have been recorded by NOAA since 1950.

Subsidence

There is currently no known database for subsidence and sinkhole events occurring in Charles County, but a review of news stories includes some of the following occurrences:

- In the Town of La Plata, during September of 2011, residents reported seeing two sinkholes form along Route 301 after heavy rainfall (WUSA9, 2011b).
- On Friday, July 28, 2017 heavy rain caused a corrugated steel storm water drain pipe running under a Charles' County resident's property to collapse. Damages included a trench running that ran half the length of backyard engulfing two fallen trees (Maryland Independent, 2017).

3.3.2.3 Future Occurrence

Earthquake

The likelihood of a hazard event happening is usually expressed in terms of frequency. It is critically important to establish a probability of occurrence so that community officials can make informed decisions about the sustainability of future development and determine the feasibility of proposed mitigation projects. One way to define an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. Peak ground acceleration (PGA) measures the strength of ground movements in this manner. PGA represents the rate in change of motion of the earth's surface during an earthquake as a percent of the established rate of acceleration due to gravity. As shown in Figure 3.3.2-1, Charles County has a very low PGA ratio of 0.06. In contrast, the western United States has a peak ground acceleration almost ten times that of Charles County.

Landslide

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

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

Storm induced debris flows are landslides likely to cause death and injuries. As residential and recreational development increases on and near steep mountain slopes, the hazards from these rapid events will also increase.

Subsidence

Future occurrences of subsidence events are difficult to estimate given the limited reported past occurrences. However, subsidence events are likely to occur after heavy rain, heavy snow fall, hurricanes, and flooding. Although a sinkhole can form without warning, specific signs can signal potential development:

- Slumping or falling fence posts, trees, or foundations
- Sudden formation of small ponds
- Wilting vegetation
- Discolored well water
- Structural cracks in walls, floors

Due to the nature of geology in the region and the lack of karst or carbonate rock present in Charles County the likelihood of a hazard event due to subsidence is unlikely. However, the extraction of materials from an underground mine can cause the overlying earth to sink, which is called mine subsidence. The extent of mine subsidence depends on the mining method, depth of mining, material extracted, and local geology. While no known mine subsidence events have been reported thus far, there is the potential for these events to occur in the future. However, most mining activity in Charles County occurs are surface mines rather than underground mines.

Overall, the probability of an earth disturbance event (earthquake, landslide, or subsidence) impacting Charles County is considered *possible* (2 out of 4) as defined by the Risk Factor Methodology probability criteria.

3.3.2.4 Vulnerability Assessment

Earthquake

Based on past earthquake activity in proximity to Charles County, earthquake frequencies are relatively low. At the same time, earthquakes with low probability could result in high-consequence events. Although earthquakes may occur infrequently they can have devastating impacts. Ground shaking can lead to the collapse of buildings and bridges; disrupt gas, life lines, electric, and phone service. Deaths, injuries, and extensive property damage are possible vulnerabilities from this hazard. Some secondary hazards caused by earthquakes may include fire, hazardous material release, landslides, flash flooding, avalanches, tsunamis, and dam failure. Moderate and even very large earthquakes are inevitable, although very infrequent, in areas of normally low seismic activity. Consequently, buildings in these regions are seldom designed to deal with an earthquake threat; therefore, they are extremely vulnerable.

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

Earthquakes give little to no warning. They are capable of having a large impact on an area. The impacts of an earthquake can be similar to that of a tornado. After-effects from an earthquake can include impacted roadways, downed power and communication lines, and damages to structures (especially poorly built, or those already in disrepair). Earthquakes are not a seasonal hazard, and thus can be experienced year-round. This can present its own set of issues.

As stated previously, the probability for a seismic event in Charles County is low. However, if for some reason an event was to occur with the County near the epicenter, there is no way to comprehend the amount of damage that could be sustained by the County.

Landslide

Landslides have the potential to damage or destroy homes and other structures, transportation routes, utilities, naturally occurring ecosystems, create travel delays, and impede on day to day life. However, death and injuries due to landslides are rare in Maryland, but could potentially occur.

While the majority of landslide susceptibility is relatively low throughout the County, the northwestern portion of the County and northwest Bennsville had moderate levels of landslide susceptibility. Additionally, developed areas of the County on or near steep slopes have increased vulnerability. For purposes of assessing landslide vulnerability in Charles County, structures and critical facilities were intersected with landslide prone areas, which were defined as areas with slope grades of 15% or greater. Based on this analysis, roughly 2.65% of critical facilities and 8.20% structures are in landslide areas (as seen in Table 3.3.2-4 below). Of the three incorporated jurisdictions in Charles County, the Town of La Plata has the greatest percentage of structures (11.73%) and critical facilities (6.1%) in landslide hazard areas. However, unincorporated areas of Charles County had the greatest number of structures (4,907) and critical facilities (12) in landslide areas throughout the entire County.

Table 3.3.2-5 shows a list of all critical facilities in areas with slopes of 15% or greater in Charles County. This indicates that in the event of a landslide, religious centers, health and childcare facilities, communication services, hydraulic services, and a police station could be at risk. Despite low probability of landslide occurring in Charles County, a landslide event involving a critical facility listed below could lead to injury or loss of life, destroy natural ecosystems, damage structures, and impede mobility and emergency response functions.

Table 3.3.2-4: Structures and Critical Facilities Vulnerable to Landslide

MUNICIAPLITY	TOTAL STRUCTURES	TOTAL STRUCTURES IN LANDSLIDE AREAS	PERCENT STRUCTURES IN LANDSLIDE AREAS	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES IN LANDSLIDE AREAS	PERCENT CRITICAL FACILITIES IN LANDSLIDE AREAS
Charles County Unincorporated Areas	61,656	4,907	7.96%	573	12	2.09%
Town of Indian Head	1,680	139	8.27%	23	1	4.35%
Town of La Plata	4,126	484	11.73%	82	5	6.10%
Village of Port Tobacco	11*	0	0.00%	0	0	0.00%
Total	**67,473**	**5,530**	**8.20%**	**678**	**18**	**2.65%**

** The Village of Port Tobacco noted that there are 22 structures in the jurisdiction; however, this analysis was conducted with GIS data which only included 11.*

Table 3.3.2-5: Structures and Critical Facilities Vulnerable to Landslide

NAME	TYPE	COMMUNITY
Good Samaritan Presbyterian Church	Churches	Charles County Unincorporated Areas
Indian Head Baptist Church	Churches	Town of Indian Head
Maryland Point Baptist Mission	Churches	Charles County Unincorporated Areas
Board of Education of Charles County MD	Communication Facilities	Charles County Unincorporated Areas
Jones Communications Of MD, Inc.	Communication Facilities	Charles County Unincorporated Areas
Potomac Electric Power Co.	Communication Facilities	Charles County Unincorporated Areas
Gilbert Run	Dams	Charles County Unincorporated Areas
Lake Jameson	Dams	Charles County Unincorporated Areas
Trinity Church	Dams	Charles County Unincorporated Areas
Claires Day Care	Day care centers	Town of La Plata
Southern MD Electric Coop Inc.	Electric substation	Charles County Unincorporated Areas
Assisted Living At Hawkins Gate	Nursing homes and long-term care facilities	Charles County Unincorporated Areas
CCSO Headquarters	Police Stations	Town of La Plata
Buckeye Circle Investments, LLC.	Pump Stations	Town of La Plata
Cliffton WWTP	Pump Stations	Charles County Unincorporated Areas
Haldane Pump Station	Pump Stations	Town of La Plata
Willowgate Pump Station	Pump Stations	Town of La Plata
Thomas Court Water Supply Co. Inc.	Wells	Charles County Unincorporated Areas

There are also 18 sites on the National Register of Historic Places and 53 sites on the Maryland Inventory of Historic Properties located in landslide hazard areas, which are discussed in more detail in Section 4.3.3.

Subsidence

Subsidence vulnerability is not consistent throughout Maryland, and risk is greater in areas with higher concentrations of karst or carbonate rock. While Charles County is not underlain with karst or carbonate rock, it has witnessed occurrences of minor sinkholes after heavy rain. Impacts of subsidence events can result in changes to elevation, and structural damage to storm drains, sanitary sewers, wells, roads, railroads, canals, levees, bridges, and public and private buildings.

3.3.2.5 Jurisdictional Differences

Earthquake

Charles County is located in a zone where earthquake vulnerability is expected to be relatively low; however, all jurisdictions in Charles County are considered equally susceptible to the impacts of an earthquake event.

Landslide

Based on the results of the vulnerability assessment, the Towns of La Plata and Indian Head, as well as certain portions of the unincorporated areas of Charles County are at a greater risk to landslide. Additionally, the northwestern section of the County near Indian Head may be more susceptible according to the USGS landslide susceptibility map. The Village of Port Tobacco has the lowest risk to landslide, with no structures or critical facilities located in areas with steep slopes.

Subsidence

All jurisdictions in Charles County have an equal risk to subsidence, although future mining activities could potentially increase risk in some areas.

3.3.2.6 Land Use and Development Trends

Earthquake

Considering the areas adjacent to Charles County have experienced low magnitude, low impact earthquakes, the likelihood of future damages due to earthquake events is low. Increased population and development may increase risk due to increased exposure of assets and populations to the hazard; however, continued enforcement of building and construction codes to mitigate earthquake vulnerabilities will continue to minimize risk.

Landslide

As residential and recreational development increases on and near susceptible coastal and geologic formations, landslide vulnerability is likely to increase. The risk of landslides can be reduced by avoiding construction on steep slopes and existing landslide hazard areas through land use controls, or by stabilizing slopes. Stability increases when groundwater is prevented from rising in the landslide mass by covering the landslide with an impermeable membrane, directing surface water away from the landslide, draining groundwater away from the landslide, and minimizing surface irrigation. Slope stability is also increased when a retaining structure and the weight of a soil/rock berm are placed at the toe of the landslide, or when mass is removed from the top of the slope.

Subsidence

Sinkhole formation is aggravated and accelerated by urbanization. Development increases water usage, alters drainage pathways, overloads the ground surface, and the redistribution soil. The formation of new sinkholes has been connected to land use practices, particularly from groundwater pumping, mining, construction, and development practices. Changes to natural water-drainage systems, and land surface changes are also correlated with sinkholes. For instance, when industrial runoff-storage ponds are formed, the weight of new material could trigger an underground collapse forming a sinkhole. Groundwater can also help keep surface soil in place, and groundwater pumping for irrigation and water supplies could disrupt balanced groundwater fluid pressures, resulting in a sinkhole. Given this information future mining, irrigation, and construction activity in Charles County should be conducted with caution.

3.3.3 Erosion

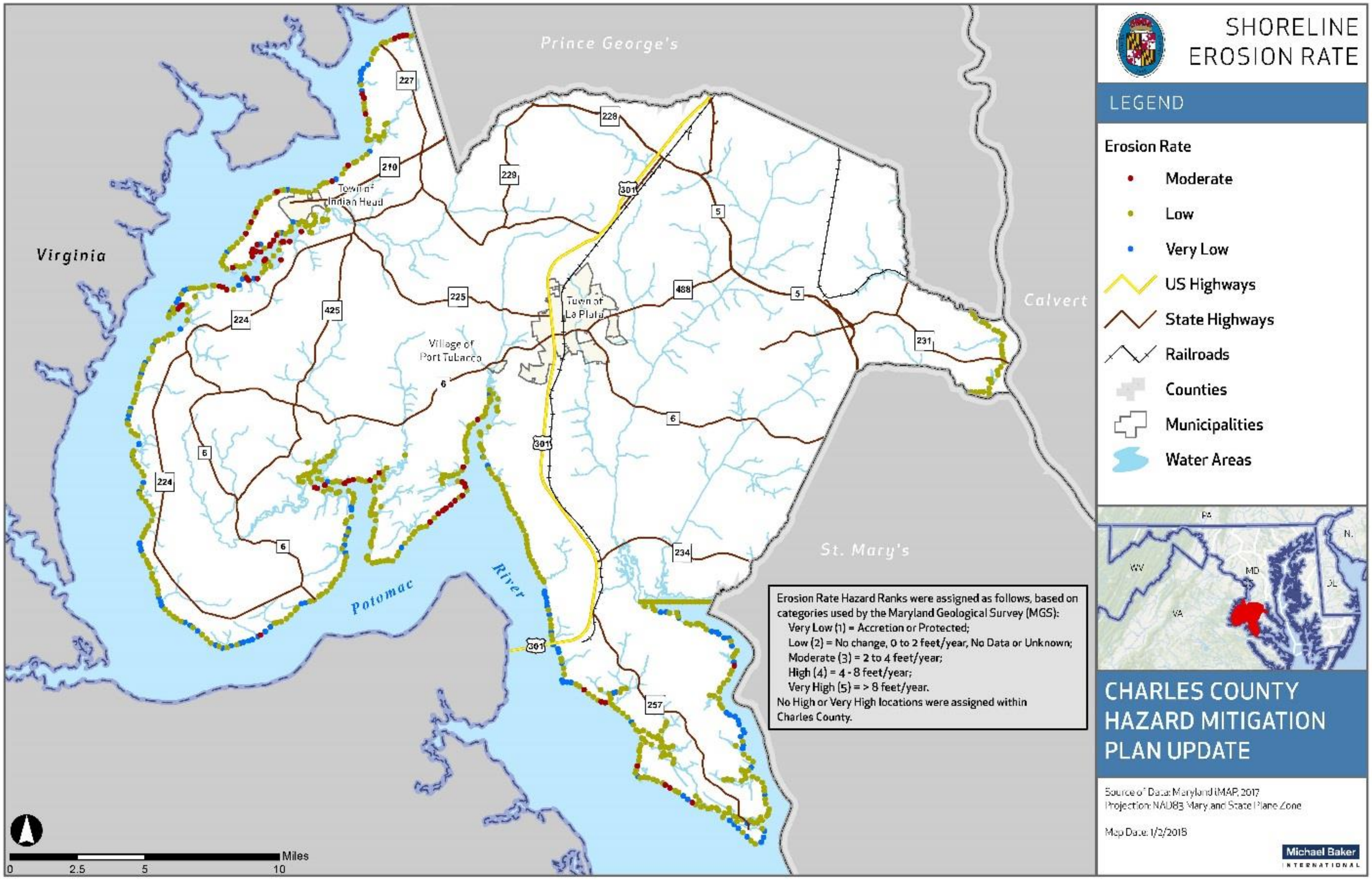
HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING (PRIORITY)
Natural	3	1	1	1	3	1.8
LOW RISK (Less than 2.0)						

3.3.3.1 Location, Extent, and Range of Magnitude

Erosion refers to the movement of soil particles by gravity, wind, water and ice. In Charles County, shoreline erosion places land, property, infrastructure, and habitat at significant risk. The U.S. Army Corps of Engineers (USACE) found that 31 percent of tidal shorelines in Charles County are experiencing some erosion, with 7 percent experiencing significant erosion rates of two feet per year or more (USACE, 1990). Subsequent studies by the Maryland Geological Survey (MGS) estimated shoreline erosion by comparing recently mapped shorelines (1988-1995) to historical maps. These studies divided Maryland’s shoreline into segments of 80 meters or more, generalized erosion rates into four categories, and assigned each shoreline segment to the most representative category. According to data made available through the Maryland Coastal Resiliency Assessment, the MGS found approximately 9% of the County’s coastline to be subject to significant erosion rates of two feet per year or more (The Nature Conservancy, 2016). As shown in Figure 3.3.3-1, the areas subject to significant erosion are concentrated near the Indian Head peninsula, the mouth of Nanjemoy Creek, and the mouth of Port Tobacco River.

High shoreline erosion rates pose a significant threat to property owners, the public, and the County’s natural resources - placing valuable land and assets at greater risk of storm damage. These assets include homes, businesses, historic and cultural sites, archaeological sites, recreational beaches, productive farmland, utilities, bridges, and roads. Shoreline erosion also contributes to the degradation of water quality and habitat. The nitrogen and phosphorus carried with eroded sediments can exacerbate summertime dead zones in the Chesapeake Bay and tidal Potomac, and the sediment itself can smother important aquatic resources and fill navigational channels used for commerce and recreation.

Figure 3.3.3-1: Shoreline Erosion Rate (Maryland Coastal Resiliency Assessment, 2016)



3.3.3.2 Past Occurrence

Shoreline erosion is a continuous process that is highly spatially variable and temporally episodic. The basic progression of erosion from wave action includes: A) attack by waves, B) erosion of a bank and beach causing undercutting, C) slumping of the bank, and D) removal, transportation, and deposition of bank sediments along shorelines. The natural drivers of this process include weather, soil composition, topography, bathymetry (water depth), and fetch (the distance traveled by wind or waves across open water). Shoreline erosion tends to be greatest when storms amplify wind and wave action, and where soils are loose, slopes are steep, near-shore waters are deep, and fetch is large. In Charles County, the shoreline is highly vulnerable to nor'easters, tropical storms and hurricanes, particularly when these storms last 24 to 48 hours and are accompanied by high winds and storm surges. For past occurrences of hurricanes, tropical storms, and nor'easters, please see Section 3.3.6.2. Storms of this type can amplify several high tide cycles, inundating protective beaches and marshes and subjecting upland areas to the brunt of the destructive wave energy. The results can include damage to shoreline stabilization projects and severe erosion of land masses.

The man-made drivers of shoreline erosion include land use and erosion control projects. Shoreline erosion tends to be greatest where upland areas generate significant runoff, and where adjacent shorelines are hardened with erosion control measures (such as revetments and bulkheads). Poorly designed erosion control measures accelerate shoreline erosion by reducing the supply of sediment to adjacent beaches, removing natural features that dampen wave action, or otherwise interrupting natural shoreline processes.

3.3.3.3 Future Occurrence

The risk of shoreline erosion is expected to increase in the future due to more intense weather events and rising sea levels driven by climate change. Both factors contribute to erosion by amplifying natural coastal processes. For example, as sea level rises, storm surges will extend further into the coastal zone, exposing upland areas to destructive wave energy with greater frequency.

Tide gauge measurements in the Chesapeake Bay and Mid-Atlantic region show that sea level along Maryland's coastline has risen at an average rate of 3-4 mm per year, or approximately one foot per century. This rate is nearly double the global average, and reflects both global sea level rise and local land subsidence. Research indicates that land subsidence in southern Maryland is the result of postglacial crustal movement, sediment loading, tectonic activity, and possibly groundwater withdrawals (Maryland DNR, 2001; MGS, 2016). Future rates of sea level rise along Maryland's coastline are also expected to exceed the global average, resulting in a rise of 2-3 feet in the next 100 years (MGS, 2016). The potential of sea level rise to exacerbate erosion rates requires careful consideration of this factor in any shoreline erosion control plan.

3.3.3.4 Vulnerability Assessment

The costs associated with shoreline erosion include the direct loss of land and its economic, cultural, and ecological values, as well as offsite impacts caused by increased sediment and nutrient loading to the Chesapeake Bay and its tributaries. Without appropriate mitigation measures, improvements such as houses, driveways, sewer pipes, or roads can be damaged or destroyed. This damage can lead to both public and private costs. Public costs may include: lower tax revenue from reduced property values, capital budget expenses to repair or replace lost infrastructure, loss of historic properties or cultural sites, loss of recreational beaches, and the loss of productive farmland and forest that serve as the basis for a sustainable rural economy.

For purposes of assessing vulnerability, the County focused on the direct loss of land and its potential impact on public and private structures, historic properties, and critical facilities. The land vulnerable to loss was estimated based on a shoreline change transect database produced by MGS. The database generalizes average annual erosion rates into five categories: accretion, 0-2 feet, 2-4 feet, 4-8 feet, and greater than 8 feet. To develop a conservative estimate of the land vulnerable to erosion, the highest average erosion rate in each category was assumed to prevail, and the average erosion rate was assumed to remain constant over the next 100 years. In 100 years' time, the shoreline was therefore estimated to retreat 200 feet for transects in the 0-2 feet per year category, 400 feet for transects in the 2-4 feet per year category, and 800 feet for the transects in the 4-8 feet per year and greater than 8 feet per year categories. Based on these assumptions, buffers were generated around the point at which each transect intersects the current shoreline, and the structures within the buffer area were identified. Note that this is an order of magnitude estimate. Erosion rates are highly variable across space and time and are dependent on many localized shoreline characteristics.

Table 3.3.3-1: displays the number of public and private structures estimated to be vulnerable to erosion in the next 100 years, categorized by land use type. Overall, 878 of the approximately 67,500 structures in Charles County were determined to be vulnerable to erosion over a span of about 100 years. Most are residential structures located in the County's unincorporated areas, and a smaller number are residential structures in Indian Head in agriculture use. Note that the commercial land use type includes commercial-residential uses and country clubs.

Table 3.3.3-1: Structures Vulnerable to Coastal Erosion

MUNICIPALITY	RESIDENTIAL	AGRICULTURAL	COMMERCIAL	INSTITUTIONAL	INDUSTRIAL	TOTAL
Charles County Unincorporated	656	84	38	48	1	827
Town of Indian Head	51	0	0	0	0	51
Total	**707**	**84**	**38**	**48**	**1**	**878**

Table 3.3.2-2 displays the number of properties on the Maryland Inventory of Historic Properties estimated to be vulnerable to erosion. Overall, 59 of the 1,006 properties on the inventory were determined to be vulnerable to erosion over a span of about 100 years. More than half of these properties are in the communities of Indian Head and Newburg, and most of the Indian Head properties are related to the historic Naval Ordnance Station. The 41 Charles County resources on the National Register of Historic Places were also analyzed for vulnerability to coastal erosion. Of the seven resources determined to be vulnerable to erosion, three were buildings (Marshall Hall, Mount Air, and Waverly), three were

larger sites or districts (Piscataway Park, the Mallows Bay-Widewater Historic and Archaeological District, and Mt. Aventine), and one was a historic skipjack (the Mary W. Somers). More information about the vulnerability of historic and cultural resources to the impacts of coastal erosion can be found in Chapter 4.

Table 3.3.3-2: Historic Properties on Maryland Inventory Vulnerable to Coastal Erosion

COMMUNITY	HISTORIC PROPERTIES
Accokeek	1
Benedict	2
Bryans Road	3
Charlotte Hall	1
Cobb Island	1
Faulkner	1
Indian Head	12
Issue	2
Marbury	2
Mount Victoria	2
Mt. Victoria	3
Nanjemoy	4
Newburg	15
Newport	1
Rock Point	1
Waldorf	1
Welcome	2
Wicomico Beach	1
Other	4
Total	**59**

Only one critical facility was identified as vulnerable to erosion – the Morgantown Generating Station located in the town of Newburg on the banks of the Potomac River.

3.3.3.5 Jurisdictional Differences

As shown in Table 3.3.3-1, Indian Head and the unincorporated areas of Charles County are more vulnerable to the impacts of erosion than Port Tobacco and La Plata.

3.3.3.6 Land Use and Development Trends

To determine how future development may affect vulnerability to coastal erosion, the County considered recent growth patterns and current land use regulations. First, the County compared the distribution of population growth between 2000 and 2010 to the distribution of Priority Shoreline Areas as determined by the Maryland Coastal Resiliency Assessment (The Nature Conservancy, 2016). Priority Shoreline Areas are coastal areas where natural habitats provide the greatest protection to nearby communities. Tier 1 areas provide the highest level of protection, and Tier 2 areas provide a more moderate level of protection. Land development that removes or degrades natural habitats in these areas could increase vulnerability to erosion. The three areas where recent development trends appear to pose the greatest threat to protective habitats are the shorelines along the Stump Neck Peninsula, the Bryans Road area, and the Cobb Neck peninsula (see Figure 3.3.3-2).

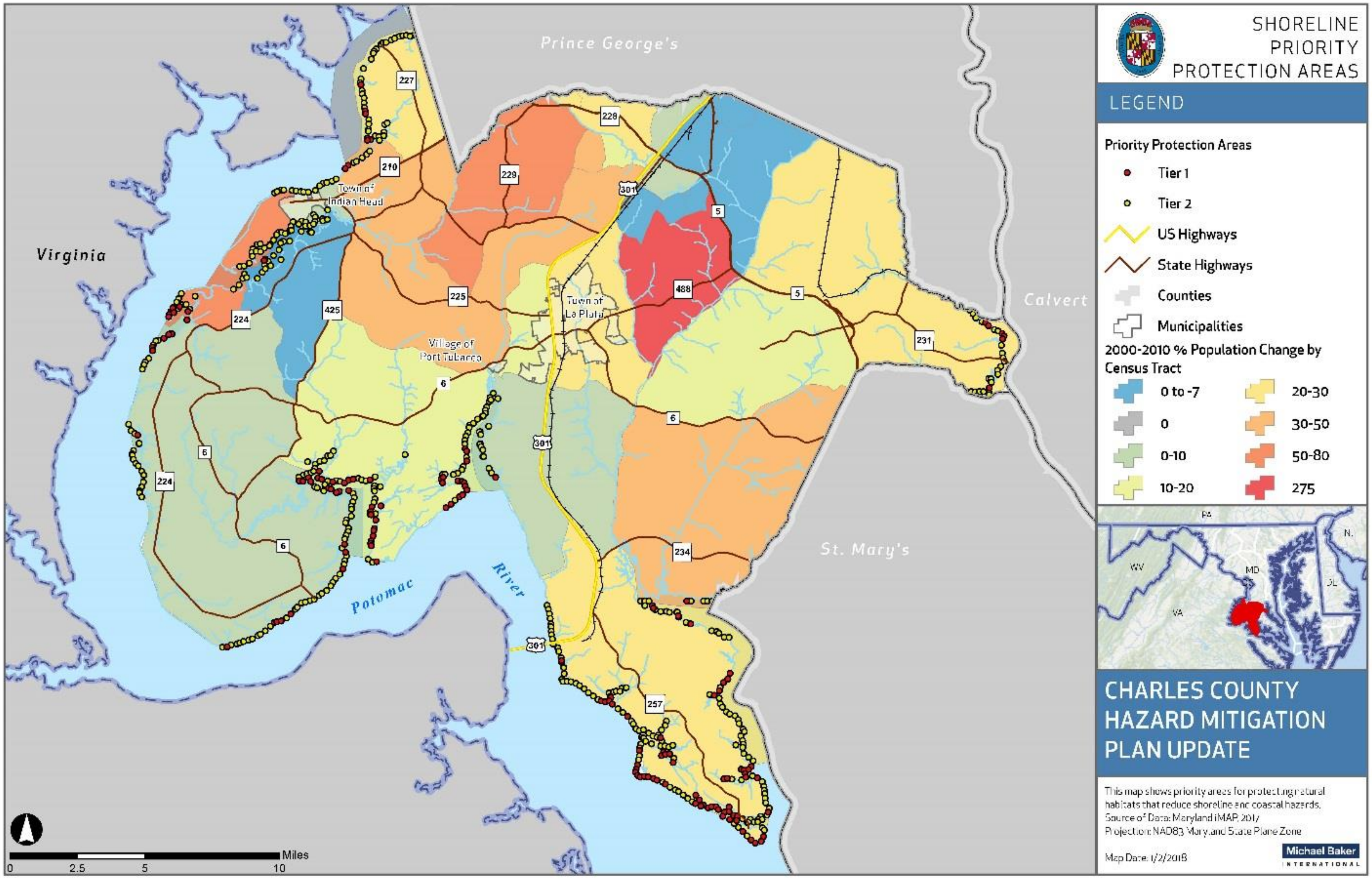
Next, the County reviewed existing land use regulations for development along the shoreline. Even in areas where new development occurs near protective natural habitats or vulnerable shorelines, existing land use regulations will likely protect new structures and infrastructure from the risk of erosion. The Chesapeake Bay Critical Area law requires Charles County to adopt and implement a Critical Area management ordinance for all land within 1,000 feet of tidal waters. The ordinance is intended to protect both water quality and wildlife habitat, and includes criteria addressing development density, water dependent uses, buffers from waterways, and protections for natural shorelines and wildlife habitats. In addition, Maryland’s Living Shoreline Protection Act of 2008 includes provisions for existing development.

Any improvements to protect private property from shoreline erosion are required to consist of marsh creation or other nonstructural shoreline stabilization measures that preserve the natural environment.

Charles County is also currently undertaking a planning effort for the National Pollutant Discharge Elimination System (NPDES) MS4 permit, and more broadly to increase coastal resilience within the County. The project is being managed by Southern Maryland Resource Conservation and Development (RC&D) and overseen by the Department of Planning and Growth Management. The immediate goal of the project is to determine areas in most need of shoreline erosion control in order to identify and undertake projects to earn credit toward the County's MS4 impervious surface restoration goals and Total Maximum Daily Load (TMDL) nutrient reduction credits. As a result of this initiative and resulting projects, coastal resilience will increase and thereby reduce the County's vulnerability to erosion hazards and potential climate change impacts.

The County's review of recent growth patterns and current land use regulations suggests that future development is unlikely to increase vulnerability to erosion.

Figure 3.3.3-2: Shoreline Priority Areas and Population Growth Rate



3.3.4 Extreme Weather

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Natural	4	3	4	4	1	**3.4**
HIGH RISK (3.0 or higher)						

3.3.4.1 Location, Extent, and Range of Magnitude

Extreme weather can occur during any season in Charles County. For the 2018 Charles County HMP, Extreme Weather is defined as thunderstorms, tornadoes, wind storms, lightning, and hailstorms. Several of these hazards were profiled separately during the 2012 HMP Update, while several are new for 2018. Thunderstorms that are associated with high winds, heavy precipitation, and lightning strikes can all be hazardous under the right conditions and locations. Strong winds and tornadoes can take down trees, damage structures, tip high profile vehicles, and create high velocity flying debris. Large hail can damage crops, dent vehicles, break windows, and injure or kill livestock, pets, and people. Dangerous and damaging factors of a severe storm include tornadoes, hail, lightning strikes, flash flooding, and winds associated with downbursts and microbursts. Reported severe weather events over the past 60 years provide an acceptable framework for determining the magnitude of such storms that can be expected and planned for accordingly.

Thunderstorms

Thunderstorms affect relatively small areas when compared with hurricanes and winter storms. Despite their relatively smaller size, all thunderstorms are dangerous. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. Of the estimated 100,000 thunderstorms that occur each year in the United States, about 10 percent are classified as severe. The National Weather Service considers a thunderstorm severe if it produces hail at least 3/4 inch in diameter, winds of 58 MPH or stronger, or a tornado. Every thunderstorm needs three basic components: (1) moisture to form clouds and rain, (2) unstable air which is warm air that rises rapidly, and (3) lift, which is a cold or warm front capable of lifting air to help form thunderstorms.

Tornadoes

A tornado is a violently rotating funnel-shaped column of air that extends from a thunderstorm cloud towards the ground. Tornadoes can touch the ground with winds of over 300 mph. While relatively short-lived, tornadoes are intensely focused and are one of nature's most violent storms. Funnel clouds, also associated with tornadoes, are rapidly rotating columns of air that do not make complete contact with the ground.

Tornadoes usually form from one of three types of thunderstorms: 1) squall-lines, 2) multicells, and 3) supercells. Supercell thunderstorms are rotating storms containing what is known as a mesocyclone, or a rotating updraft (column of air) from which tornadoes sometimes form. Supercell thunderstorms have a greater potential than other thunderstorms for producing severe weather, including tornadoes.

Tornadoes can range from just several yards to over two miles in width, and have the potential to destroy nearly everything in their path. Although tornadoes normally travel on the ground for short distances, tornado tracks of 200 miles or more have been reported. Tornado paths average 4 miles in length, but may reach up to 300 miles. 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 miles per hour, 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 potential devastation to an area. The destructive power of a 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.

Tornado movement is characterized in two ways: direction and speed of spinning winds, and forward movement of the tornado, also known as the storm track. The forward motion of the tornado path can be a few hundred yards or several hundred miles in length. The width of tornadoes can vary greatly, but generally range in size from less than 100 feet to over a mile in width. Some tornadoes never touch the ground and are short-lived, while others may touch the ground several times. Downbursts are characterized by straight-line winds. Downburst damage is often highly localized and resembles that of tornadoes. There are significant interactions between tornadoes and downbursts; 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, left or even taking a U-turn.

Previously, tornado damage was measured on the Fujita Scale, also called the FScale, named for Dr. Tetsuya Theodore Fujita. The operational Fujita scale ranges from an F0 to an F5. The strongest tornadoes observed to date have been F5 (winds between 261-318 mph). An Enhanced Fujita Scale (EF Scale) was developed and implemented operationally by the National Weather Service (NWS) in 2007. The EF Scale was developed to better align tornado wind speeds with associated damages. A description of this scale is shown in Table 3.3.4-1.

Table 3.3.4-1: Enhanced Fujita Scale (EF-Scale): Categories, Wind Speeds, and Associated Effects

EF-SCALE	WIND SPEED (mph)	DESCRIPTION OF EFFECTS	F-SCALE NUMBER
EF0	**65-85**	**Minor damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.	F0-F1
EF1	**86-110**	**Moderate damage**: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.	F1

Table 3.3.4-1: Enhanced Fujita Scale (EF-Scale): Categories, Wind Speeds, and Associated Effects

EF-SCALE	WIND SPEED (mph)	DESCRIPTION OF EFFECTS	F-SCALE NUMBER
EF2	**111-135**	**Considerable damage**: Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.	F1-F2
EF3	**136-165**	**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; structures with weak foundations blown away some distance.	F2-F3
EF4	**166-200**	**Devastating damage**: Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.	F3
EF5	**>200**	**Extreme damage**: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (300 ft.); steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation.	F3-F6

Tornadoes and wind storms can occur throughout Charles County, though events are usually localized. However, severe thunderstorms may result in conditions favorable to the formation of numerous or long-lived tornadoes. Tornadoes can occur at any time during the day or night, but are most frequent during late afternoon into early evening, the warmest hours of the day, and most likely to occur during the spring and early summer months of March through June.

Windstorms

Windstorms are violent gusts of air with typically little to no rain. Windstorms can also produce derechos (Spanish for “straight”), which are prolonged bursts of hurricane force winds occurring in a straight line. Straight-line winds and windstorms are experienced on a more region-wide scale. While such winds usually accompany tornadoes, straight-line winds are caused by the movement of air from areas of higher pressure to areas of lower pressure. Stronger winds are the result of greater differences in pressure. Windstorms are generally defined with sustained wind speeds of 40 mph or greater lasting for one hour or longer, or winds of 58 mph or greater for any duration of time.

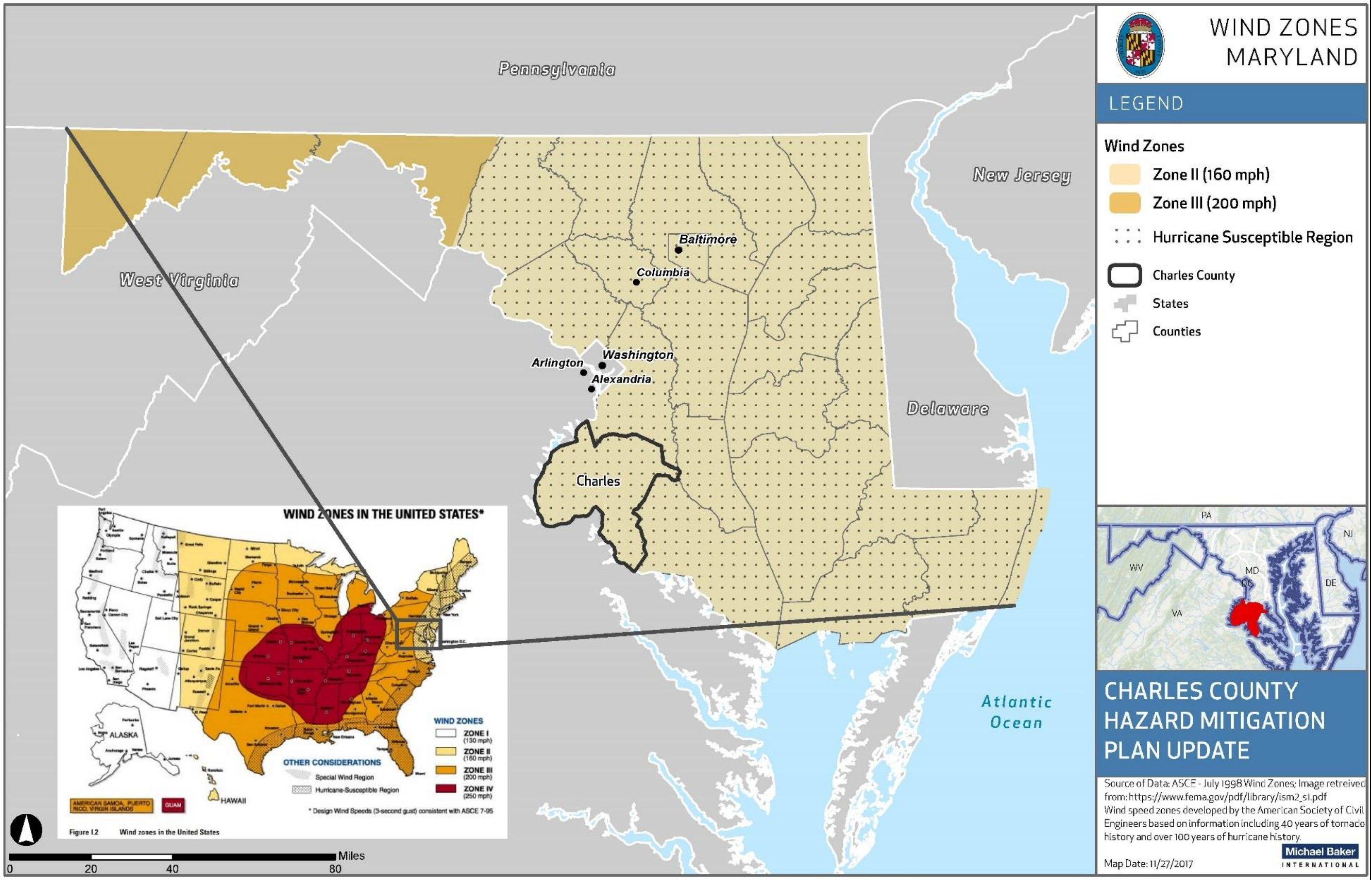
A downburst is an area of strong, downward moving air associated with a downdraft from a thunderstorm. As the downdraft impacts the ground, the air is forced outwards in all directions while it also curls backwards. This results in incredible wind damage close to the surface of the ground, as well as horizontal rotation midway up between the ground and the base of the thundercloud. Downbursts may last anywhere from a few minutes in small-scale microbursts, to extended periods of up to 20 minutes in larger, longer macro-bursts. Wind speeds of downbursts can reach 150 mph and can result in damages comparable to a tornado. Often, downbursts can produce straight-line wind damage over an area as small as 1 mile to as large as 250 miles from the center of the downdraft. In fact, a downburst that spans a distance of less than 2.5 miles in diameter is considered a microburst.

Microbursts last for about five minutes and can cause wind speeds in excess of 160 mph. Because of their extremely fast winds, incredible wind shear and relatively small size, microbursts prove hazardous to aircrafts and have been the cause of tragic airplane crashes, including the 1985 Delta Airlines Flight 191 crash in Dallas-Fort Worth. Conversely, downbursts that span greater than 2.5 miles in radius are called macrobursts. Macrobursts can last nearly half an hour and produce wind speeds in excess of 130 mph. According to NOAA, macrobursts can produce wind damage comparable to an EF-3 tornado.

Not only are windstorms often a precursor to more serious storms, windstorms have also been known to cause flying debris, tree damage, power outages, damages to homes, structures, and crops. Inventory assets vulnerable to high winds are dependent on the age of the building, type, construction material used, and condition of the structure. Structures are susceptible to lateral loads, as the winds impact the flat surfaces of a building. In addition, uplift forces can impact structures, as the winds move not just in straight lines, but at angles as well.

FEMA places the Charles County region in Zone II (160 MPH) for structural wind design (Federal Emergency Management Agency, 1998), as displayed in Figure 3.3.4-2 below. The county is also entirely located in the Hurricane Susceptible Region.

Figure 3.3.4-2: Wind Speed Zones in Maryland



Lightning

Lightning is a discharge of electrical energy resulting from the build-up of positive and negative charges within a thunderstorm. The flash or "bolt" of light usually occurs within clouds or between clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000°F.

Each year, lightning is responsible for the death of almost one hundred people, injuries to several hundred more, and millions of dollars in property damage in the United States (NOAA NWS, 2012). In many cases, heart damage, inflated lungs, or brain damage have resulted from lightning strikes, leading to death. Loss of consciousness, amnesia, paralysis, and burns are reported by many who have survived. Deaths and injuries to livestock and other animals, thousands of forest and brush fires, as well as millions of dollars in damage to buildings, communications systems, power lines, and electrical systems have also been results of lightning.

Lightning events occur across the entirety of Maryland. Different areas experience varying event frequencies, but in all cases, lightning strikes occur primarily during the summer months. While the impact of flash events is highly localized, strong storms can result in numerous widespread events over a broad area. In addition, the impacts of an event can be serious or widespread if lightning strikes a particularly significant location, such as a power station or large public venue.

Lightning, although not considered severe by the National Weather Service’s definition, can accompany heavy rain during thunderstorms. Lightning develops when ice particles in a cloud move around, colliding with other particles. These collisions cause a separation of electrical charges. Positively charged ice particles rise to the top of the cloud and negatively charged ones fall to the middle and lower sections of the cloud. The negative charges at the base of the cloud attract positive charges at the surface of the Earth. Invisible to the human eye, the negatively charged area of the cloud sends a charge called a stepped leader toward the ground. Once it gets close enough, a channel develops between the cloud and the ground. Lightning is the electrical transfer through this channel. The channel rapidly heats to 50,000 degrees Fahrenheit and contains approximately 100 million electrical volts. The rapid expansion of the heated air causes thunder.

Hail

Hail develops when a super cooled droplet collects a layer of ice and continues to grow, sustained by the updraft. Once the hail stone cannot be held up any longer by the updraft, it falls to the ground. Nationally, hailstorms cause nearly $1 billion in property and crop damage annually, as peak activity coincides with peak agricultural seasons. Severe hailstorms also cause considerable damage to buildings and automobiles, but rarely result in loss of life.

Large hail can damage structures, break windows, dent vehicles, ruin crops, and kill or injure people and livestock. Based on past occurrences, hail sizes greater than 1.75 inches in diameter are possible and should be accounted for in future planning activities.

3.3.4.2 Past Occurrence

There have been over five hundred recorded extreme weather that have either directly or indirectly impacted Charles County since 1960. Reported injuries, deaths, property damage, and crop damage have been significant. The following tables depict past storm occurrences using data gathered from The National Oceanic and Atmospheric Administration (NOAA).

Thunderstorms

The following table displays 89 recorded thunderstorm events with heavy rainfall, which took place within Charles County from 1950 until 2017. Past occurrences of heavy winds associated with thunderstorms are highlighted in the discussion of past occurrences of windstorms. One event in 1997 caused $3,000 in property damage from heavy rain and gusty winds and caused power outages throughout the area.

Table 3.3.4-1: Thunderstorm (Heavy Rain) Events (NOAA, 2017)

YEAR OF EVENT	NUMBER OF EVENTS	NUMBER OF INJURIES	NUMBER OF DEATHS	CROP DAMAGE	PROPERTY DAMAGE
1950-2012	89	0	0	$0	$3,000
2013	0	0	0	$0	$0
2014	0	0	0	$0	$0
2015	0	0	0	$0	$0
2016	0	0	0	$0	$0
2017	0	0	0	$0	$0
Total	**89**	**0**	**0**	**$0**	**$3,000**

**Past occurrences of thunderstorm wind events are discussed with past occurrences of windstorms.*

Tornado

Charles County reported a total of 26 tornado events, including tornado funnel cloud sightings from 1950 to 2017. Of these, the most devastating was one on April 28th, 2002. A destructive tornado crossed the County from just north of Rison, through La Plata, to Benedict before moving into Calvert County. This tornado left a 64-mile path of destruction ranging from F1 to F4 damages. The tornado first touched down on the eastern edge of General Smallwood State Park just north of Rison. The tornado (F4 strength), continued east into the downtown area where it crossed through the intersection of Routes 301 and 6. Damage was found on either side of Route 6, with the most severe devastation occurring on the south side of the highway. The downtown business district was nearly wiped out after 65 percent of the buildings were either heavily damaged or destroyed. The Civista Hospital on Charles Street, Town Hall and the police station on Garrett Avenue, the Rescue Squad building on Calvert Street, Archbishop Neale School, and Blessed Lambs Pre-School on Route 6 were all damaged during the tornado event. The full length of the tornado reached 24 miles long, and resulted in three reported casualties, 122 injuries, and 115 million dollars' worth of property damages. An estimated 638 homes were damaged, 100 homes were destroyed, 143 businesses (mostly in the town center of La Plata) were damaged, and 49 businesses were destroyed (NOAA, 2017). A 51-year-old man was fatality injured when his home collapsed on Hawkins Gate Road, located 5 miles east of La Plata. The other two deaths which occurred were due to heart failure. Innumerable trees and agricultural buildings fell along the path of the storm as well. Figure 3.3.4-2 depicts damage from this event along Maple Avenue in La Plata.

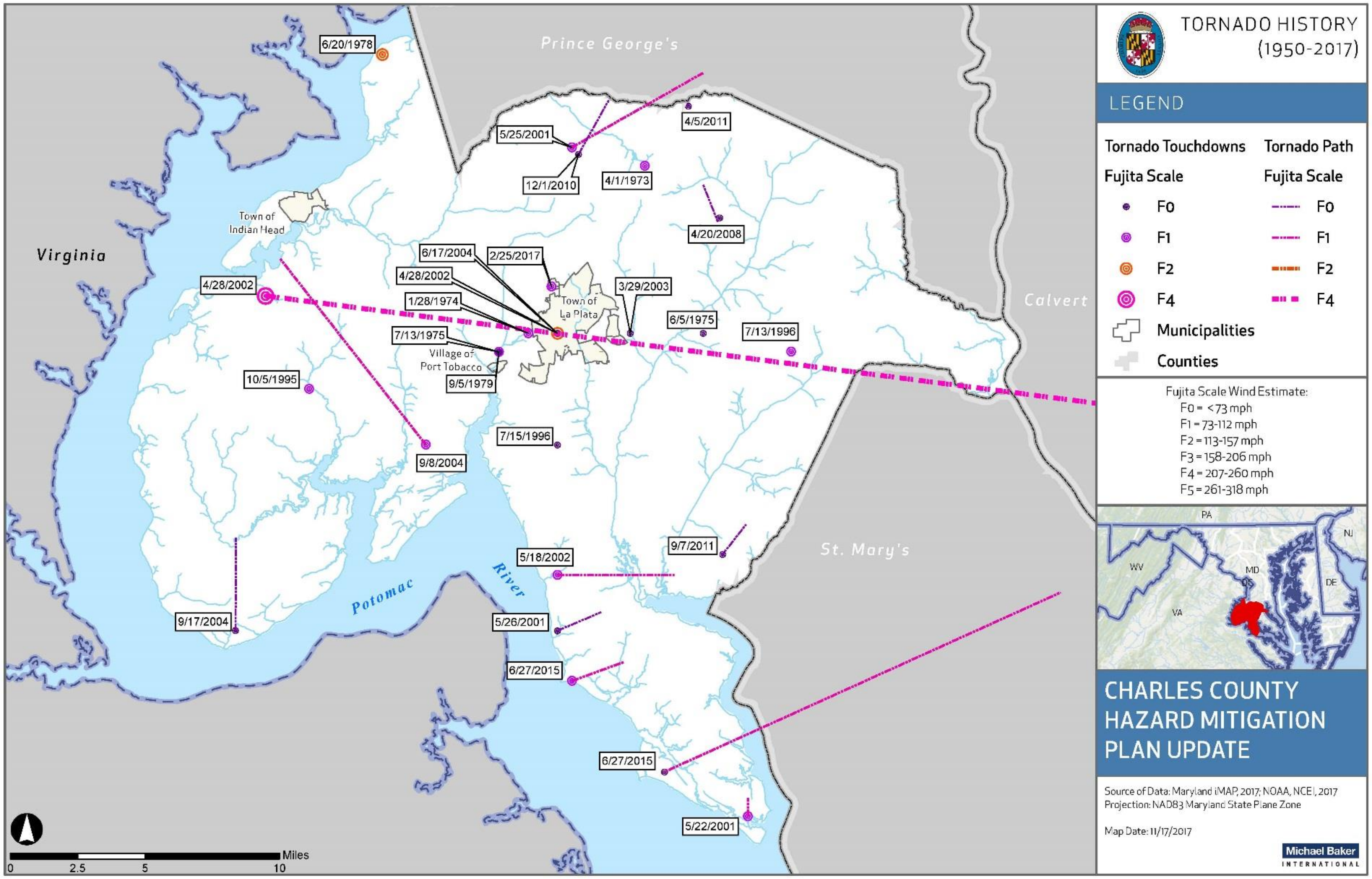
Figure 3.3.4-2: Impacts of the 2002 tornado in La Plata (Charles County, 2002).

Figure 3.3.4-2: Impacts of the 2002 tornado in La Plata (Charles County, 2002).

Another notable storm occurred on November 11, 1995. An apparent microburst knocked down tens of trees along Chapel Point Road near State Route 6 in the Port Tobacco area just southwest of La Plata. Several large oaks were among them, and one caused $125,000 in damage to a home. Physicians Memorial Hospital in Waldorf reported four times the usual Saturday night "business"; however, whether any of the services were storm-related (to injury) was not determined.

Figure 3.3.4-2 below depicts the paths of tornadoes that have occurred in Charles County from 1950 until 2017, notably the F4 tornado which took place on April 28th, in 2002.

Figure 3.3.4-3: Tornado History of Charles County Since 1950



The following table displays tornado and funnel cloud events which have occurred in Charles County from 1950 until 2017. While 27 events were reported, there is also the possibility that other events occurred but went unreported. These 27 events caused an estimated $116,707,000 in property damages and $10,000 in crop damages.

Table 3.3.4-2: Tornado and Funnel Cloud Events (NOAA, 2017)

YEAR OF EVENT	NUMBER OF EVENTS	NUMBER OF INJURIES	NUMBER OF DEATHS	CROP DAMAGE	PROPERTY DAMAGE
1950-2012	24	122	1	$10,000	$116,204,000
2013	0	0	0	$0	$0
2014	0	0	0	$0	$0
2015	2	0	0	$0	$503,000
2016	0	0	0	$0	$0
2017	1	0	0	$0	$0
Total	**27**	**122**	**1**	**$10,000**	**$116,707,000**

Windstorms

Table 3.3.4-3 below displays windstorm events which have occurred in Charles County from 1950 until 2017. This list includes thunderstorm wind and high wind events reported in Charles County. There was a total of 302 reported occurrences of events meeting these criteria. These events caused several injuries, one death, and extensive property and crop damage.

Table 3.3.4-3: Windstorm Events (NOAA, 2017)

YEAR OF EVENT	NUMBER OF EVENTS	NUMBER OF INJURIES	NUMBER OF DEATHS	CROP DAMAGE	PROPERTY DAMAGE
1960-2012	227	1	1	$0	$2,042,290
2013	11	0	0	$6,000	$7,000
2014	17	0	0	$5,000	$10,000
2015	15	0	0	$0	$24,000
2016	16	1	0	$0	$4,000
2017	16	0	0	$0	$0
Total	**302**	**2**	**1**	**$11,000**	**$2,087,290**

A significant contribution to property damage, an estimated $125,000, occurred in La Plata on November 11th, 1995. The damage had occurred from an apparent microburst, which knocked down several oak trees along Chapel Point Road near State Route 6 in the Port Tobacco area just southwest of La Plata. One of the fallen trees resulted in $100,000 in damage to a home. Thunderstorm wind resulted in further property damage to the Naval Annex, which knocked down a six telephone poles along with a fallen tree limb which damaged a boat. Another significant windstorm event was the result of a nor'easter on April 16th, 2007, which left thousands of Maryland residents without power when high winds downed trees and power lines. An estimated $10,000 in property damages were recorded (NOAA, 2017). Additionally, Hurricane Sandy had significant wind impacts on Charles County. Heavy rain accompanied by high winds spread over coastal regions and most of Maryland. An estimated $969,190 in property damaged was the result of a windstorm event during Hurricane Sandy (NOAA, 2017). Damages included scattered trees, debris, and power outages.

Lightning

The table below displays seven reported lightning events in Charles County between 1950 and 2017, causing an estimated total of $80,000 in property damages. The most notable of these events took place on June 24th, 1996 and resulted in $20,000 in property damages. It was reported that five homes were struck by lightning near the area of Cobb Island and the Governor Harry W. Nice Memorial Bridge. Noteworthy damages also occurred as a result of a lightning strike during a hurricane on July 10th, 2000, which caused $50,000 in property damages (NOAA, 2017). The strike started a fire at a home on Bryan's Road, which extensively damaged the structure. Wildfires caused by lightning can also potentially damage archaeological sites, as artifacts are frequently located on the surface of sites. Figure 3.3.4-3 below displays a map of lighting events throughout the state of Maryland from 1996 until 2017. Charles County has relatively low number of reported lightning occurrences in comparison to counties such as Anne Arundel, Montgomery, and Frederick.

Table 3.3.4-4: Lightning Storm Events (NOAA, 2018)

YEAR OF EVENT	NUMBER OF EVENTS	NUMBER OF INJURIES	NUMBER OF DEATHS	CROP DAMAGE	PROPERTY DAMAGE
1960-2012	7	0	0	$0	$80,000
2013	0	0	0	$0	$0
2014	0	0	0	$0	$0
2015	0	0	0	$0	$0
2016	0	0	0	$0	$0
2017	0	0	0	$0	$0
Total	**7**	**0**	**0**	**$0**	**$80,000**

Hail

The table below depicts 82 reported hailstorm events in Charles County from 1950 to 2017. Roughly $756,500 in property damages were reported, along with $50,000 in crop damage. On May 14th, 2010 high pressure build up occurred over the western Atlantic resulting in showers and thunderstorms. The combination of cold and moist warm air caused thunderstorms to become severe with large hail being the primary threat. Hail roughly 1.75 inches was reported near Waldorf. Hundreds of cars in the Waldorf area experienced significant damages, including broken wind shields and dents. Several homes were also reported as damaged. Another notable event occurred on September 21st, 1993, when hail .75 inches was produced during a thunderstorm and causing $50,000 in crop damages on several farms near the Town of La Plata. It was also noted by a member of the HMPC during the Risk Assessment Meeting that the Charles County Health Department experienced damage to air conditions units at the facility from hail.

Table 3.3.4-5: Hailstorm Events (NOAA, 2018)

YEAR OF EVENT	NUMBER OF EVENTS	NUMBER OF INJURIES	NUMBER OF DEATHS	CROP DAMAGE	PROPERTY DAMAGE
1960-2012	70	0	0	$50,000	$756,500
2013	0	0	0	$0	$0
2014	0	0	0	$0	$0
2015	1	0	0	$0	$0
2016	9	0	0	$0	$0
2017	2	0	0	$0	$0
Total	**82**	**0**	**0**	**$50,000**	**$756,500**

Figure 3.3.4-4 shows reported occurrences of hail ranging from .75 inches to 2.00 inches throughout Charles County from 1957 until 2017. The majority of reported hail events occurred in the northeastern region of Charles County as shown in the map below; however, hailstorms may occur throughout the County, and it is highly likely that all occurrences of hail that have impacted the County areas not depicted in Figure 3.3.4-5.

Figure 3.3.4-4: Lightning Events in Charles County Since 1996

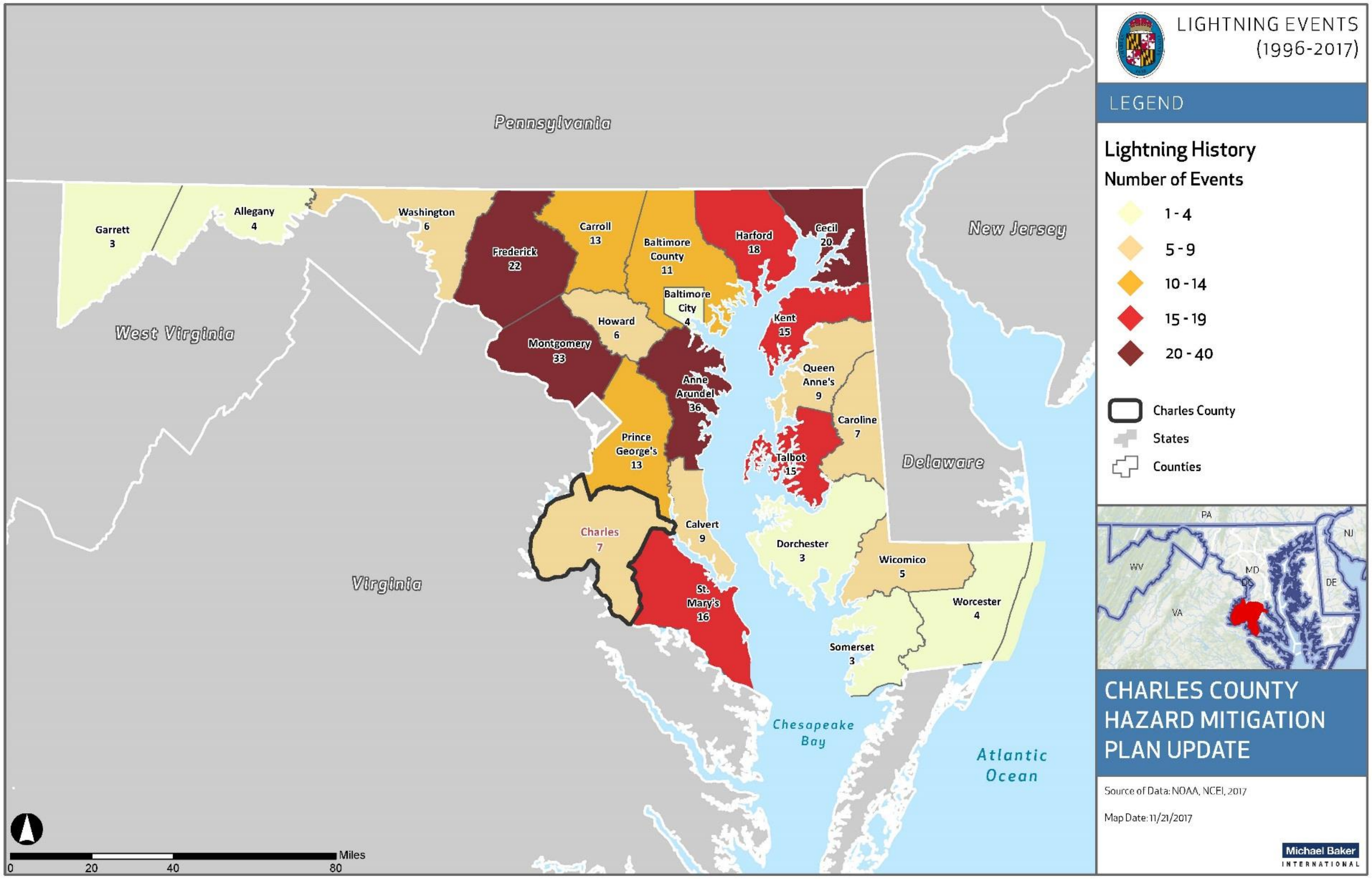


Figure 3.3.4-5: Hail Storm Events in Charles County Since 1957

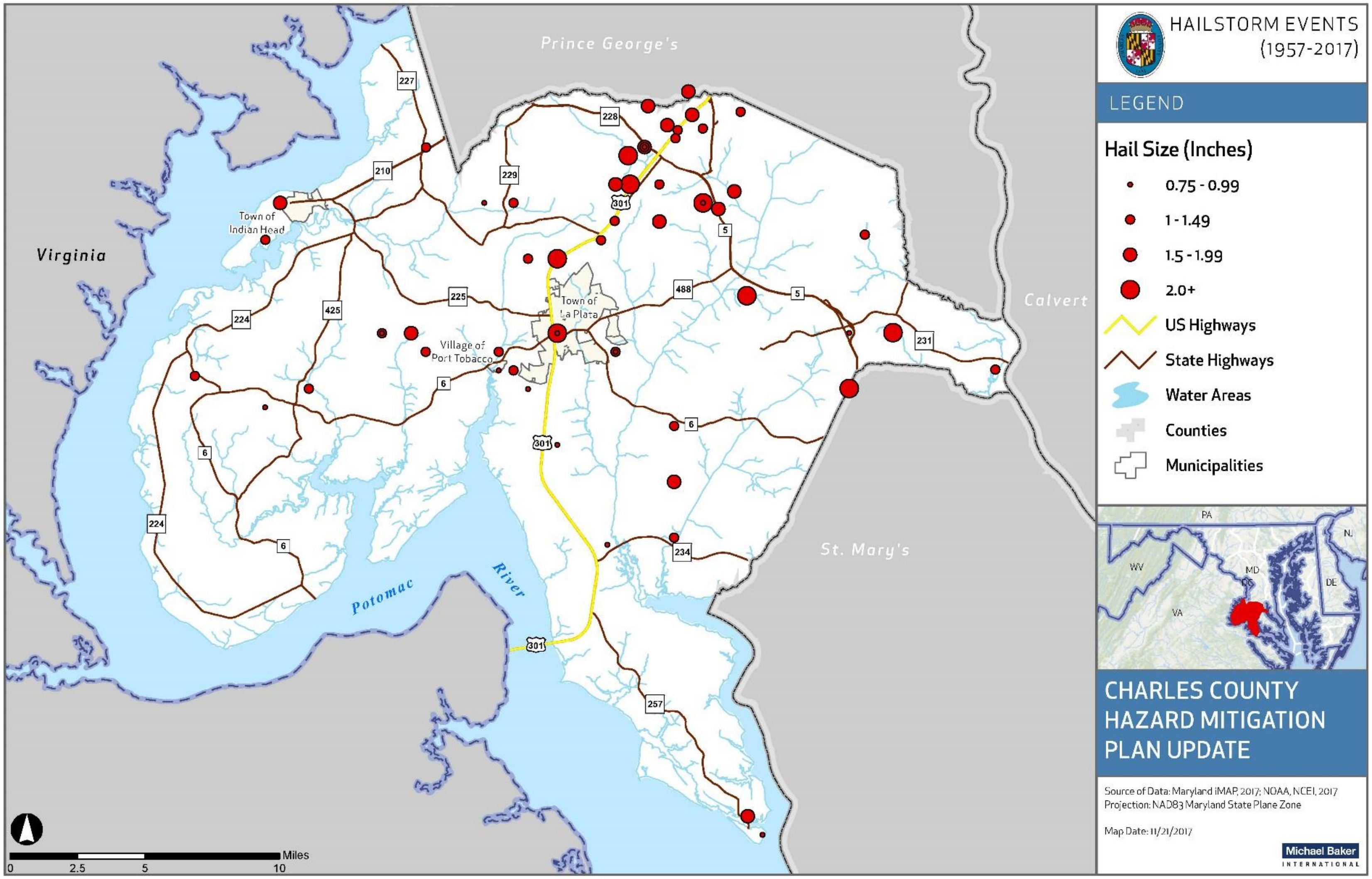


Table 3.3.4-3 below shows the total number of events for each type of extreme weather in Charles County since 1950. In total, there have been over 500 events, which have resulted in 2 deaths, 124 injuries, over $119 million in property damage, and an estimated $71,000 in crop damage.

Table 3.3.4-3: Extreme Weather Events in Charles County since 1950

EVENT TYPE	NUMBER OF EVENTS	INJURIES	DEATHS	CROP DAMAGE	PROPERTY DAMAGE
Heavy Rain	89	0	0	$0	$3,000
Tornado	27	122	1	$10,000	$116,707,000
Windstorms	302	2	1	$11,000	$2,087,290
Lightning	7	0	0	$0	$80,000
Hail	82	0	0	$50,000	$756,500
Total	**507**	**124**	**2**	**$71,000**	**$119,633,790**

3.3.4.3 Future Occurrence

Reported extreme weather events since 1950 provide an acceptable framework for determining the future occurrence in terms of frequency for such events. Each extreme weather hazard is also often accompanied by other risks. For example, thunderstorms are often accompanied by windstorms, flooding, hail, and lightning. Based on historical records, the interrelated nature of these events, and other indicators of weather systems, it can reasonably be assumed that this type of event is *highly likely* to occur (4 out of 4) as defined by the Risk Factor Methodology probability criteria. Additionally, the potential for these events to cause future damages to life and property is also relatively high, as depicted in Table 3.3.4-3.

3.3.4.4 Vulnerability Assessment

The frequency of extreme weather events is expected to increase, which increases the County's vulnerability to this hazard. Additionally, vulnerability is higher in more densely developed areas. However, all assets located in Charles County can be considered at risk to extreme weather events. This includes all of the County's population, buildings, and infrastructure. Damages primarily occur as a result of tornadoes high winds, lightning strikes, and hail, as well as flood impacts associated with these events. For a more detail assessment of the vulnerability of county assets to flooding, see Section 3.3.5.3. Most structures, including the County's critical facilities, should be able to provide adequate protection from hail but the structures could suffer broken windows and dented exteriors. Those facilities with back-up generators are better equipped to handle a severe weather situation should the power go out. One of the greatest issues for critical facilities during tornados, major windstorms, or other extreme weather events is the inaccessibility of such facilities due to debris-covered roads, utility outages, or other debris-related issues. During periods of heavy winds, roads can become impassable, due to downed trees or power lines. Power and communication lines are susceptible to damage from falling limbs, as trees are rocked by strong winds. Possible losses to critical infrastructure include:

- Electric power disruption
- Communication disruption
- Road closures

Depending on the season, downed power and communication lines can become very hazardous. These threats combined with extreme heat or cold can lead to significant threats to the population. In addition to the costs of repairing downed lines, there is the additional cost of business losses that are impossible to estimate accurately because they are not reported.

Nearly 70 percent of the deaths from tornadoes happen to people located in residential structures. Of these, over 40 percent are in mobile homes, which are easily overturned and destroyed due to their light-weight and often unanchored design. Manufactured homes and commercial trailers are extremely vulnerable to high winds. There are total of 701 mobile home structures in Charles County, which comprised 1.2% of all housing units. Most of these units are located in and around Waldorf and Nanjemoy. Higher concentrations of mobile home structures increase the vulnerability of the area to tornadoes, wind storms, and thunderstorms with heavy winds.

At meetings of the Strawberry Hills Civic Association (SHCA) and the Maryland Invasive Species Council, it was reported that studies indicate that about half of the trees falling down over highways during a major storm can be prevented for about 10% of the effort to control them all. For example, it requires minimal effort to cut stump non-native invasive vine, such as oriental bittersweet, at ground level and apply glyphosate to the cut stump. It has been reported that fallen trees the impact electric power lines can cause electric power outages and subsequent brush fires.

3.3.4.5 Jurisdictional Differences

Due to the regional nature of extreme weather, all jurisdictions within Charles County are vulnerable to the potential impacts of these events. However, population and building density has a correlation with hazard vulnerability and loss. In particular, the urban and suburban areas have higher population and structure densities, such as La Plata, Indian Head, and communities throughout unincorporated areas of the County may be more vulnerable to the impacts of these events. Additionally, areas with taller buildings that can act as lightning rods have experienced greater vulnerability and loss during past lightning events. The environmental impacts most often associated with lightning strikes include damage or death to trees and ignition of wildfires. Jurisdictions that are heavily forested and that have, in the past, experienced wildfires that start because of a lightning strike are also vulnerable to losses due to lightning. For more information about wildfire vulnerability in Charles County, please see Section 3.3.9. Additionally, older homes that are in deteriorating condition and mobile homes are also more susceptible to severe storms that generate high winds. Therefore, areas with heavier concentrations of these structures, such as mobile homes in Waldorf and Nanjemoy, are more vulnerable to the impacts of extreme weather.

3.3.4.6 Land Use and Development Trends

All future structures and infrastructure built in Charles County will likely be exposed extreme weather events and may experience damage. Since the previous statement is assumed to be uniform countywide, the location of development does not increase or reduce the risk necessarily. By adhering to building codes, Charles County and its jurisdictions can ensure that new development is built to current standards for wind resistance.

3.3.5 Flood

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Natural	3	3	3	4	2	**3**
HIGH RISK (3.0 or higher)						

3.3.5.1 Location, Extent, and Range of Magnitude

A flood is a natural event for rivers and streams and occurs when a normally dry area is inundated with water. Excess water from snowmelt or rainfall accumulates and overflows onto stream banks and adjacent floodplains. Flash floods, usually resulting from heavy rains or rapid snowmelt, can flood areas not typically subject to flooding, including urban areas. Extreme cold temperatures can cause streams and rivers to freeze, causing ice jams and creating flood conditions. Charles County contains a number of rivers, streams, and ditches that could potentially flood. Severe flooding would affect most Charles County waterways and, in turn, would impact properties that represent a variety of use.

Floods are considered hazards when people and property are affected. Nationwide, hundreds of floods occur each year, making it one of the most common hazards in all 50 states and U.S. territories. In Maryland, flooding occurs commonly and can occur during any season of the year from a variety of sources. Most injuries and deaths from flooding happen when people are swept away by flood currents and most property damage results from inundation by sediment-filled water. Fast-moving water can wash buildings off their foundations and sweep vehicles downstream. Pipelines, bridges, and other infrastructure can be damaged when high water combines with flood debris. Basement flooding can cause extensive damage. Flooding can cause extensive damage to crop lands and bring about the loss of livestock. Several factors determine the severity of floods, including rainfall intensity and duration, topography, and ground cover.

Riverine flooding originates from a body of water, typically a river, creek, or stream, as water levels rise onto normally dry land. Water from snowmelt, rainfall, freezing streams, ice flows, or a combination thereof, causes the river or stream to overflow its banks into adjacent floodplains. Winter flooding usually occurs when ice in the rivers creates dams or streams freeze from the bottom up during extreme cold spells. Spring flooding is usually the direct result of melting winter snow packs, heavy spring rains, or a combination of the two.

Flash floods can occur anywhere when a large volume of water flows or melts over a short time period, usually from slow moving thunderstorms or rapid snowmelt. Because of the localized nature of flash floods, clear definitions of hazard areas do not exist. These types of floods often occur rapidly with significant impacts. Rapidly moving water, only a few inches deep, can lift people off their feet, and only a depth of a foot or two, is needed to sweep cars away. Most flood deaths result from flash floods. The table below shows the different causes associated with flooding and flash flooding.

Table 3.3.5-1: Causes of flooding and flash flooding	
CAUSES OF FLOODING	**CAUSES OF FLASH FLOODING**
Low lying topography, relatively undisturbed	Hilly/mountainous areas
High season water tables	High velocity flows
Poor drainage	Short warning times
Excess paved surfaces	Steep slopes
Constructions-filling	Narrow stream valleys
Obstructions-bridges	Parking lots and other impervious surfaces
Soil characteristics	Improper drainage

Urban flooding is the result of development and the ground's decreased ability to absorb excess water without adequate drainage systems in place. Typically, this type of flooding occurs when land uses change from fields or woodlands to roads and parking lots. Urbanization can increase runoff two to six times more than natural terrain. (National Oceanic and Atmospheric Administration, 1992). The flooding of developed areas may occur when the amount of water generated from rainfall and runoff exceeds a storm water system's capability to remove it.

Ice Jams are stationary accumulations of ice that restrict flow. Ice jams can cause considerable increases in upstream water levels, while at the same time, downstream water levels may drop. Types of ice jams include freeze up jams, breakup jams, or combinations of both. When an ice jam releases, the effects downstream can be similar to that of a flash flood or dam failure. Ice jam flooding generally occurs in the late winter or spring.

Flooding is normally the result of a larger event such as a thunderstorm, rapid snowmelt, and/or ice jam. Flooding can be as frequent as the occurrence of a spring rain or summer thunderstorm. The amount of precipitation produced by storm events determines the type of flooding. Flash floods, which typically occur more frequently than general floods, occur along small streams and creeks of the type that are widely present throughout southern Maryland.

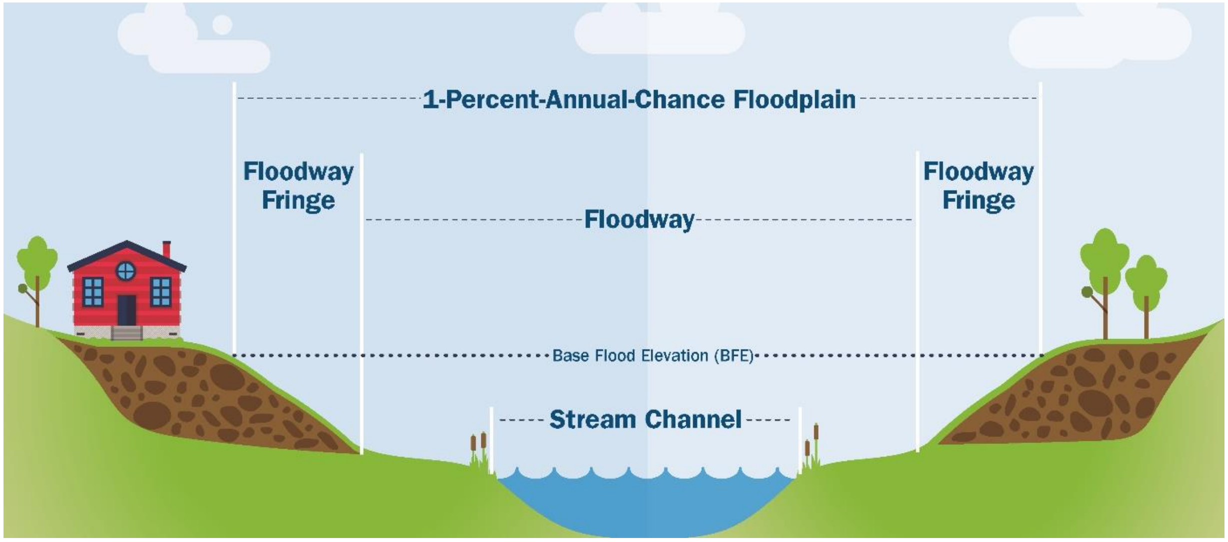
Table 3.3.5-2: List of Flood Sources in Charles County (FEMA, 2015)	
FLOOD SOURCES	**FLOOD SOURCES**
Clark Run	Murphy Run
Jordan Swamp	Piney Branch
Kerrick Swamp	Piney Branch Tributaries
Mattawoman Creek	Potomac River
Old Womans Run	Patuxent River Tributaries
Patuxent River	Wicomico River
Zekiah Swamp Run	Creek Oaks Rim
Beaver Dam	Oden Run
Bowman Creek	Old Womans Run
Budds Creek	Piney Branch and Tributaries

Table 3.3.5-2: List of Flood Sources in Charles County (FEMA, 2015)

FLOOD SOURCES	FLOOD SOURCES
Burgess Creek	Pomonkey Creek
Denton Run	Popes Creek
Devils Nest	Port Tobacco Creek and Tributaries
Ditchley Prong	Reeder Run and Tributaries
Gilbert Creek	Ross Branch
Gilbert Swamp Run	Smoots Pond Run
Hancock Run	Run Spring Hill Branch
Hells Bottom Run	St. Stephan Run
Hill Top Fork	Swanson Creek and Tributaries
Hoghole Run	Tributaries to Jordan Swamp
Indian Branch	Run Tributaries to Kerrick Swamp
Jane Berrys Run	Tributaries to Mattawoman Creek
Kerrick Swamp	Tributaries to Mill Dam Run
Lancaster Run	Tributaries to Piney Branch
Little Creek	Tributaries to Zekiah Swamp Run
Maddox Branch	Trinity Church Run and Tributary
Marbury Run	Wards Run and Tributaries
Mill Dam Run	Wills Branch Creek
Mill Run	Wheatley Run
Mill Swamp	

Floodplains are lowlands, adjacent to rivers, streams, and creeks that are subject to recurring floods. The size of the floodplain is described by the recurrence interval of a given flood. Flood recurrence intervals are explained in more detail in Section 3.3.3.5; however, when assessing the potential spatial extent of flooding, it is important to know that a floodplain associated with a flood that has a 10% chance of occurring in a given year is smaller than the floodplain associated with a flood that has a 0.2%-annual-chance of occurring. Flood Insurance Rate Maps (FIRMs) identify the 1%-annual-chance flood, which is used to delineate the Special Flood Hazard Area (SFHA) and identify Base Flood Elevations (BFEs). Figure 3.3.5-1 illustrates these terms. The SFHA serves as the primary regulatory boundary used by FEMA, the State of Maryland, and Charles County local governments.

Figure 3.3.5-1: Diagram identifying Special Flood Hazard Area, including the 1%-annual-chance (100-Year) floodplain, floodway, and flood fringe.



Countywide FIRMs were published for Charles County on September 4, 2013 and May 4, 2015. All communities within Charles County are now shown on a single set of countywide FIRMs. Previous FIRMs and Flood Boundary and Floodway Maps (FBFM) were digitized to produce a FIRM that is compatible with geographic information systems. An example of the mapping products published is shown in Figure 3.3.5-2. FIRMs for the entire county can be obtained from the FEMA Map Service Center. These maps can be used to identify the expected spatial extent of flooding from a 1%- and 0.2%-annual-chance event.

Figure 3.3.5-2: FIRM Panel 24017C0040D, May 4, 2015, showing flood hazard areas along the Potomac River and Pomonkey Creek

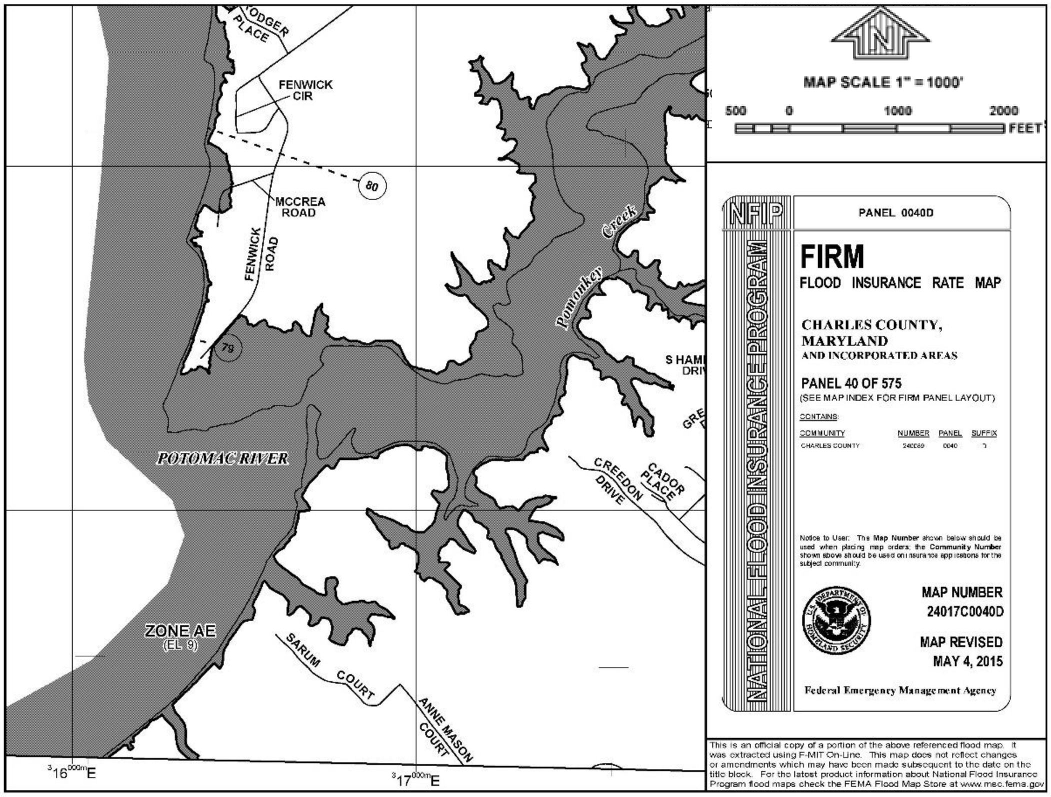


Figure 3.3.5-3 shows the flood zones in Charles County. The location of approximate and detailed (including Base Flood Elevations) Special Flood Hazard Areas (1% annual chance zones) are shown. FEMA defines Flood Zone A as the areas of approximate 1% annual chance zones, since Base Flood Elevation data is not known for the area, and Zone AE shows areas in the 1% annual chance zones determined by Base Flood Elevation details. VE zones shown on the map are coastal high hazards areas, where the computed wave heights for the 1%-annual-chance-flood are three feet or greater. Figure 3.3.5-4 shows changes since the last FIRM for coastal areas. As shown in the map, the SFHA increased in several areas along the Potomac River but decreased in other locations, such as along other parts of the Potomac River as well as the Wicomico River, Nanjemoy Creek, and the Patuxent River.

Charles County is also located in the Lower Potomac, the Patuxent, and the Middle Potomac-Anacostia-Occoquan Watersheds (see Figure 3.3.5-6).

Figure 3.3.5-3: Flood Zones in Charles County

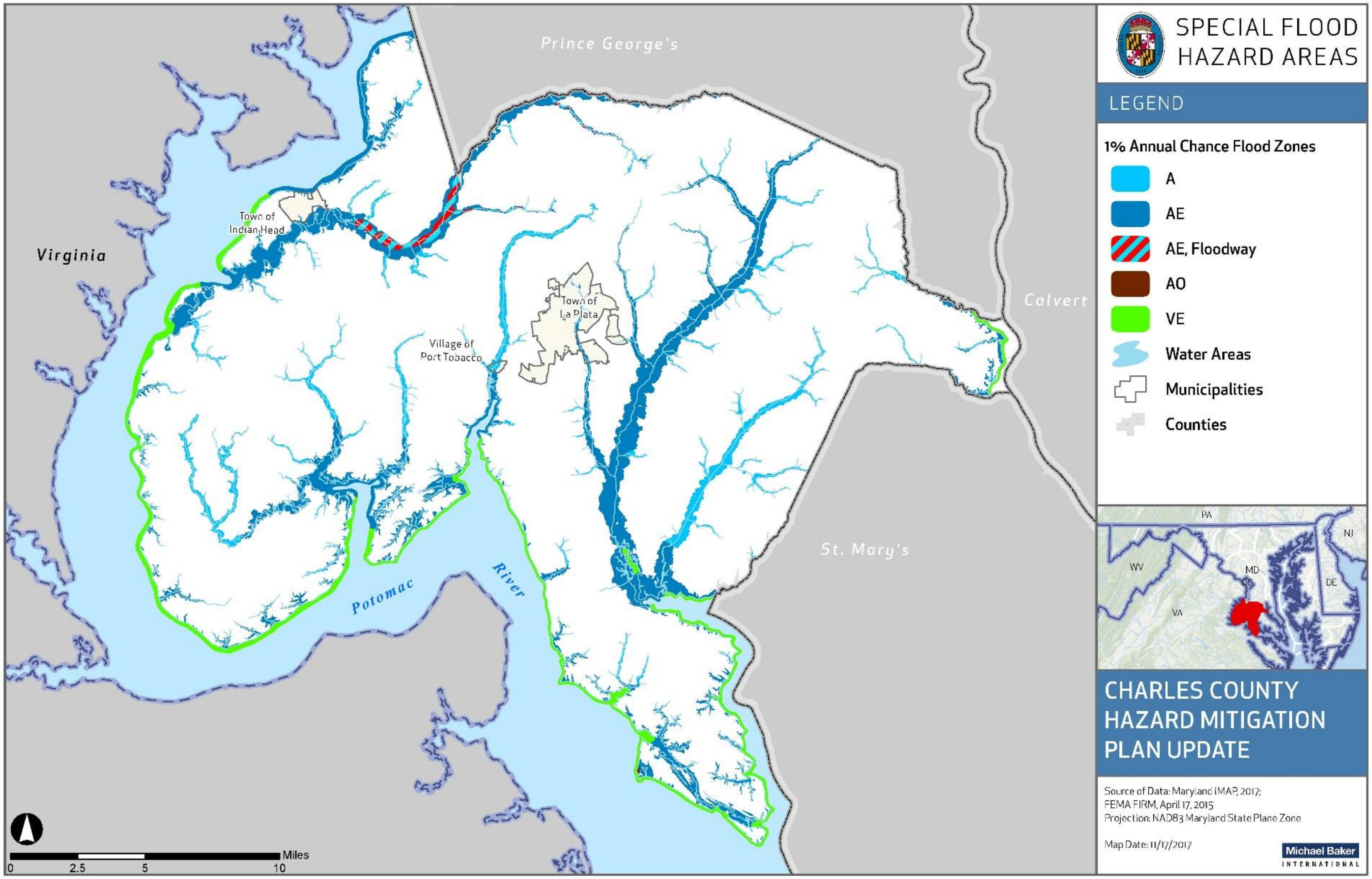


Figure 3.3.5-4: Changes Since Last FIRM

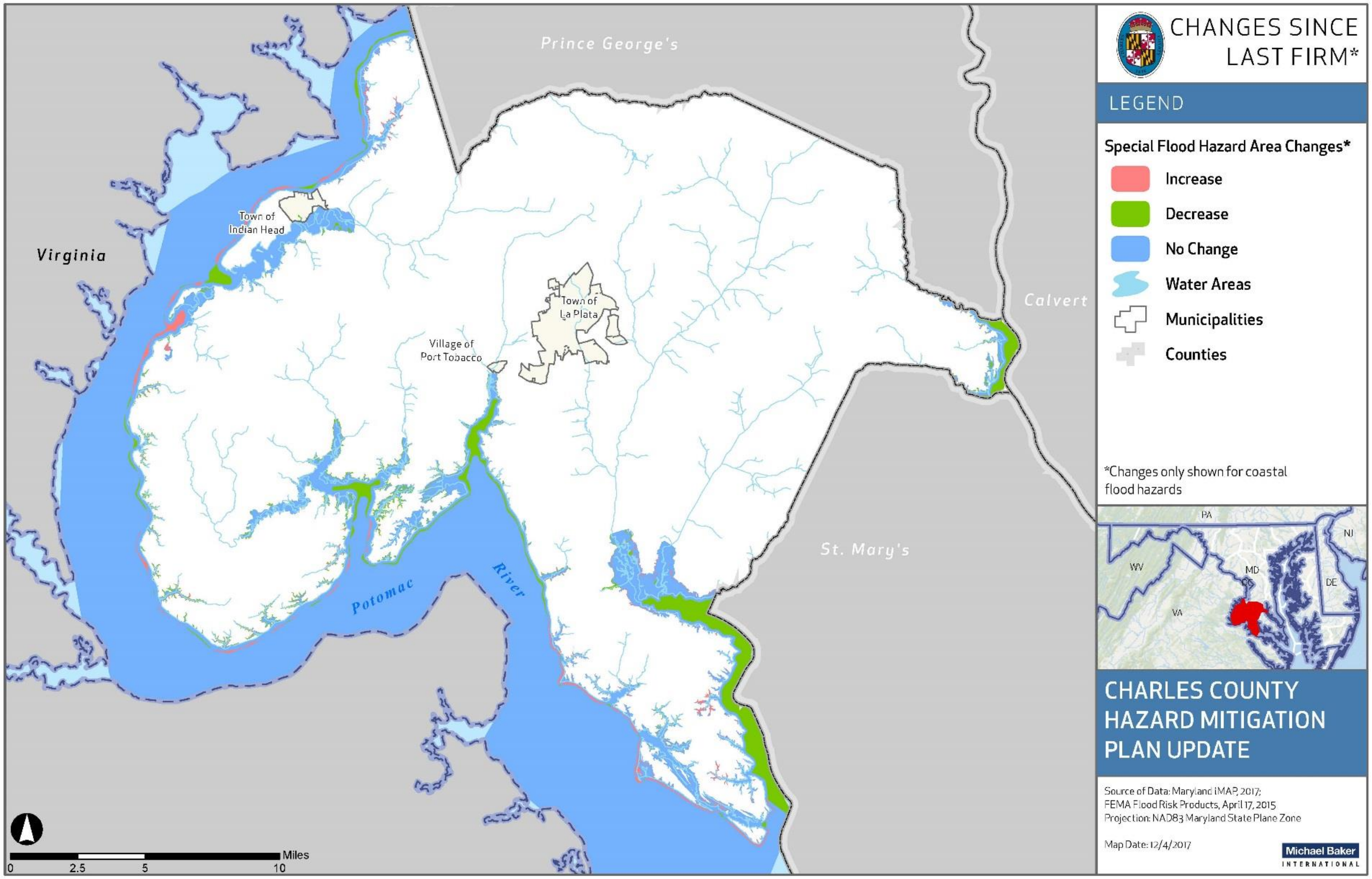


Figure 3.3.5-5: Charles County Watersheds

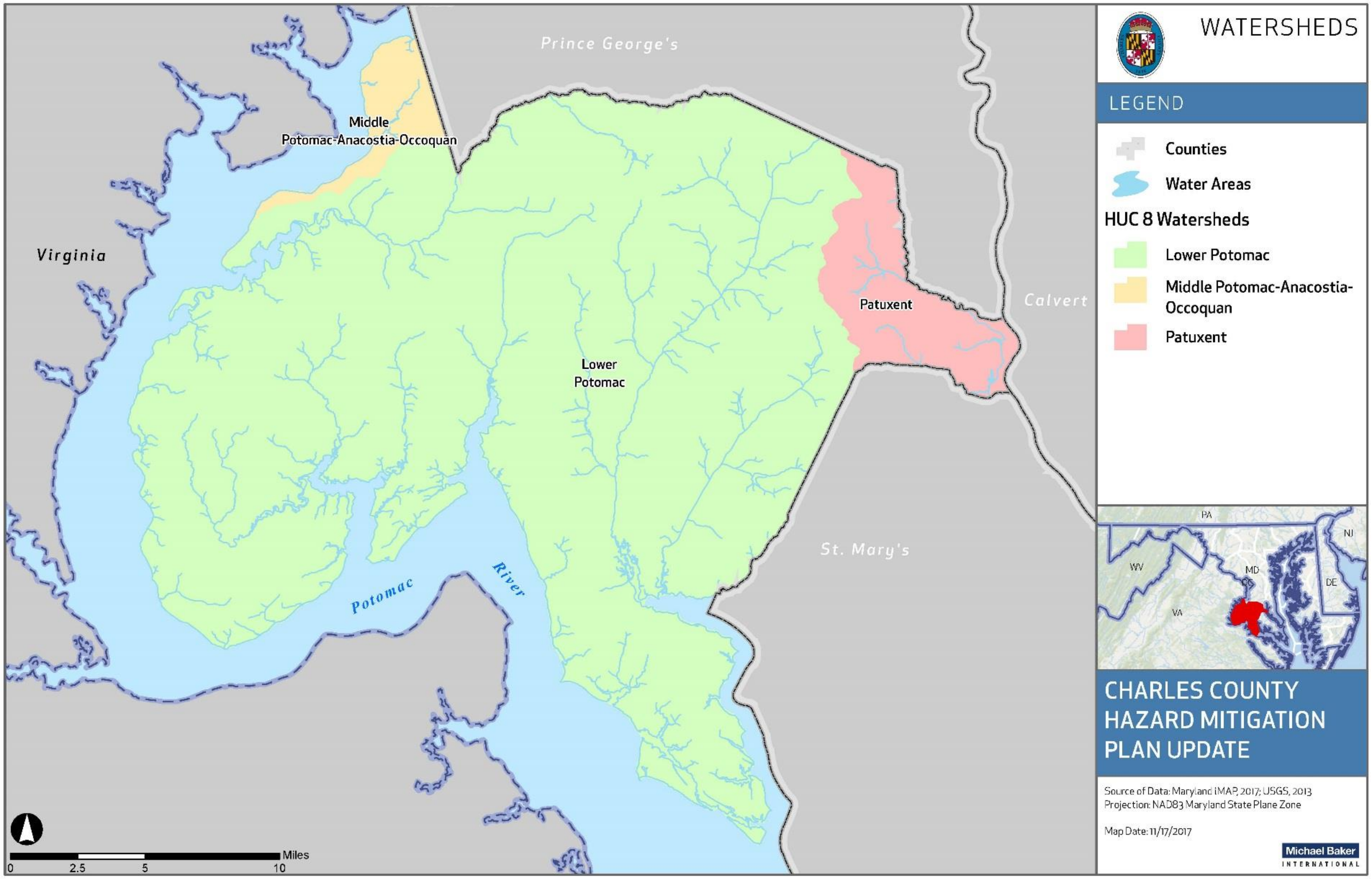


Table 3.3.5-1 below indicates municipal participation in the NFIP. The Town of Port Tobacco Village currently does not participate in the NFIP.

Table 3.3.5-1: Charles County NFIP Participation (FEMA CIS, 2018)

MUNICIPALITY	CID	NFIP ENTRY DATE	CURRENT EFFECTIVE MAP
Charles County Unincorporated	240089	6/5/1985	5/4/2015
Town of La Plata	240092	4/17/1985	5/4/2015
Town of Indian Head	240091	10/15/1985	5/4/2015

Floods are considered hazards when people and property are affected. Injuries and deaths can occur when people are swept away by flood currents or bacteria and disease are spread by moving or stagnant floodwaters. Most property damage results from inundation by sediment-filled water. A large amount of rainfall over a short time span can result in flash flood conditions. Small amounts of rain can result in floods in locations where the soil is frozen or saturated from a previous wet period or if the rain is concentrated in an area of impermeable surfaces such as large parking lots, paved roadways, or other impervious developed areas.

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover and rate of snowmelt. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover. Charles County features areas with sloping terrain, which can contribute to more severe floods as runoff reaches receiving water bodies more rapidly over steep terrain. Also, urbanization typically results in the replacement of vegetative ground cover with asphalt and concrete, increasing the volume of surface runoff and stormwater, particularly in areas with poorly planned stormwater drainage systems.

In Maryland, there are seasonal differences in how floods are caused. In the winter and early spring (February to April), major flooding has occurred as a result of heavy rainfall on dense snowpack throughout contributing watersheds, although the snowpack is generally moderate during most winters. Summer floods have occurred from intense rainfall on previously saturated soils. Summer thunderstorms deposit large quantities of rainfall over a short period of time that can result in flash flood events. In addition, as detailed in Section 3.3.6, Charles County occasionally experiences intense rainfall from tropical storms in late summer and early fall.

Floods are naturally occurring events that benefit riparian systems, which have not been disrupted by human actions. Such benefits include groundwater recharge and the introduction of nutrient rich sediment improving soil fertility. However, the destruction of riparian buffers, changes to land-use and land cover throughout a watershed, and introduction of chemical or biological contaminants which often accompany human presence cause environmental harm when floods occur. Hazardous material facilities are potential sources of contamination during flood events. Other environmental impacts of flooding include: water-borne diseases, suffocation of tree species non-tolerant to excess water, heavy siltation, damage, or loss of crops and drowning of both humans and animals.

3.3.5.2 Past Occurrence

The severity of flooding in Charles County is determined by a number of local factors, including river basin topography, precipitation patterns, recent soil moisture conditions, and groundcover/vegetative state. Charles County and its municipalities have many streams and small tributaries that are highly susceptible to flooding. The properties in and near the identified floodplains of Charles County are subject to flooding events on an almost annual basis. Floodplain management, flood control structures, hazard mitigation, and flood relief funds are strategies that have reduced Charles County's annual flood damages.

Charles County has a long history of flooding events. Small, localized flooding events occur annually with minimal property damage. According to NOAA's Storm Events Database, Charles County has been impacted by 39 flood, flash flood, and coastal flood events since 1950 (See table 3.3.5-1). Five of these events occurred since the last HMP Update. Additionally, several Presidential Disaster and Emergency Declarations affecting Charles County have been in response to hazard events related to flooding events or other storm events with flood impacts (see Table 3.2-1).

Table 3.3.5-1: Flood, Flash Flood, and Coastal Flood Events, 1950-2017 (NOAA, 2017)

YEAR OF EVENT	NUMBER OF EVENTS	NUMBER OF INJURIES	NUMBER OF DEATHS	CROP DAMAGE	PROPERTY DAMAGE
1950-2012	32	0	0	$0	$475,000
2013	0	0	0	$0	$0
2014	2	0	0	$0	$0
2015	1	0	0	$0	$0
2016	0	0	0	$0	$0
2017	2	0	0	$0	$0
Total	**39**	**0**	**0**	**$0**	**$475,000**

According to the NOAA, the greatest impact on Charles County as a result of coastal flooding event that occurred on February 4, 1998. A powerful nor'easter, carrying copious moisture from the Gulf of Mexico and Caribbean region dumped between 2 and 4 inches of rain across much of Maryland between the foothills and the Chesapeake Bay. Rainfall totals, ranging from 3 to 5 inches, fell in lower southern Maryland, causing widespread flooding of low lying areas and small streams and creeks. The nor'easter, which arrived on the heels of another just a week earlier, caused tides of 3 to 4 feet above normal from the Calvert County-Anne Arundel County line south to Point Lookout in extreme southeastern St. Mary's County; and along the lower tidal Potomac River along the Charles and St Mary's shoreline, including Cobb Island and St George Island. Inland flooding was less extensive in Charles and Calvert Counties, but a problem nonetheless. In Charles County, 25 roads were closed at the peak of the flooding, and numerous vehicles were reportedly stranded. Hydrologic observers recorded up to 4.5 inches of rain.

In Charles County alone, eighty trees and large limbs were reported down, thirty on Cobb Island. Other road closures in St. Mary's, Calvert, Anne Arundel, and southeastern Prince George's County were due to fallen trees or limbs. The combination of BG&E, PEPCO, and SMECO reported nearly 15,000 customers without power at the height of the storm. Four thousand customers were affected in St. Mary's County, 5,000 in Anne Arundel, 1,793 in Calvert, and 1,550 in southeastern Prince George's and Charles Counties.

Another significant event associated with flash flooding occurred on August 25, 1999. Flash flooding was reported in various parts of the County that resulted in property damage of approximately $200,000. Rainfall totals in Charles County ranged from around 2 inches on the west side of Waldorf to 5.7 inches about 5 miles east of town. Several portions of Acton Lane near the Mattawoman Creek were closed due to high water. The Lynnbrook subdivision in Waldorf had several homes surrounded and flooded by water, and some residents had to be rescued by firefighters. Over $100,000 damage was reported in the neighborhood. Hamilton Drive reportedly had water flowing over it like a waterfall.

Two recent events in 2017 impacted the communities of Newtown and Denstville. On July 6, 2017, heavy rainfall across the region caused flooding over the roadway near the intersection of Glen Albin Road and Spring Hill-NewTown Road in Newtown. On August 21, 2017, isolated thunderstorms caused heavy rainfall and produced flash flooding throughout Charles and St. Mary’s Counties and caused flooding on Estevez Road in the Town of La Plata.

The NFIP also identifies properties that frequently experience flooding. Floods are the most common and costly natural catastrophe. In terms of economic disruption, property damage, and loss of life, floods are “nature’s number-one disaster.” For that reason, flood insurance is almost never available under industry-standard homeowner’s and renter’s policies. The best way for citizens to protect their property against loss to flood is to purchase flood insurance through the NFIP. Congress established the NFIP in 1968 to help control the growing cost of federal disaster relief. The NFIP is administered by FEMA. The NFIP offers federally backed flood insurance in communities that adopt and enforce effective floodplain management ordinances to reduce future flood losses. Information on NFIP premiums and coverage, prior claims, and substantial damage claims provide additional information on past flood occurrences. Table 3.3.5-7 shows this information for each community in Charles County.

Table 3.3.5-7: Charles County NFIP Polices and Claims Information (FEMA CIS, 2018).

COMMUNITY	POLICIES IN FORCE	TOTAL COVERAGE	TOTAL PREMIUM	TOTAL PAID CLAIMS	TOTAL AMOUNT OF PAID CLAIMS
Charles County Unincorporated	653	$173,838,700	$473,700	201	$5,557,044
Town of La Plata	27	$6,529,000	$12,009	1	$37,145
Town of Indian Head	8	$2,165,000	$4,207	1	$21,887
Total	**688**	**$182,532,700**	**$489,916**	**203**	**$5,616,076**

The NFIP identifies repetitive loss properties as structures insured under the NFIP which have had at least two paid flood losses of more than $1,000 over any 10-year period since 1978. A property is considered a severe repetitive loss property either when there are at least four losses each exceeding $5,000 or when there are two or more losses where the building payments exceed the property value. As of August 2018, there were 27 repetitive loss properties in Charles County, all of which were located in unincorporated areas. Most of these properties were single-family residential (21), while the remaining six properties were non-residential. Charles County also has one severe repetitive loss building, which was listed in the “non-residential other” category. This structure was also located in the unincorporated areas of Charles County and accounted for five of 63 total losses in Charles County. Table 3.3.5-8 shows the number of repetitive loss properties and losses by jurisdiction and structure type.

Table 3.3.5-8: Charles County Repetitive Loss Properties and Losses by Structure Type (MEMA, 2018).

JURISDICTION	RESIDENTIAL: SINGLE FAMILY		NON-RESIDENTIAL: BUSINESS		NON-RESIDENTIAL: OTHER		TOTAL	
	PROPER-TIES	LOSSES	PROPER-TIES	LOSSES	PROPER-TIES	LOSSES	PROPER-TIES	LOSSES
Charles County Unincorporated	21	47	1	3	5*	13	27	63
Town of La Plata	0	0	0	0	0	0	0	0
Town of Indian Head	0	0	0	0	0	0	0	0
Total	**21**	**47**	**1**	**3**	**5**	**13**	**27**	**63**

** One of the properties in the non-residential other category was a severe repetitive loss property.*

3.3.5.3 Future Occurrence

In Charles County, flooding occurs commonly and can take place during any season of the year. Every two to three years, serious flooding occurs along one or more of Maryland’s major rivers or streams and it is not unusual for such events to happen several years in succession. Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and related probability of occurrence. Historical records are used to determine the probability of occurrence (percent chance) for a flood of specific extent to occur.

The NFIP recognizes the 1%-annual-chance flood, also known as the base flood, as the standard for identifying properties subject to federal flood insurance purchase requirements. A 1%-annual-chance flood is a flood, which has a 1% chance of occurring over a given year. The FIRMs published on September 4, 2013 and May 4, 2015 can be used to identify areas subject to the 1%- and 0.2%-annual-chance flooding. Areas subject to 2%- and 10%-annual-chance events are not shown on maps; however, water surface elevations associated with these events are included in the flood source profiles contained in the Flood Insurance Study Report. The probability of future flooding in Charles County can be considered *likely* (3 out of 4) according to the Risk Factor Methodology.

Table 3.3.5-9 shows a range of flood recurrence intervals and associated probabilities of occurrence.

Table 3.3.5-9: Recurrence intervals and associated probabilities of occurrence (FEMA, 2001).	
RECURRENCE INTERVAL	CHANCE OF OCCURRENCE IN ANY GIVEN YEAR (%)
10 year	10
50 year	2
100 year	1
500 year	0.2

3.3.5.4 Vulnerability Assessment

Charles County is vulnerable to flooding that could cause loss of lives, property damage, and road closures. For purposes of assessing vulnerability, this assessment focused on community assets that are located in the 1%-annual-chance floodplain. While greater and smaller floods are possible, information about the extent and depths for this floodplain is available for all jurisdictions countywide, thus providing a consistent basis for analysis.

Table 3.3.5-11 displays the number of addressable structures, critical facilities, and populations intersecting the SFHA along with the total number of addressable structures, critical facilities, and population in each community. The numbers of vulnerable addressable structures and critical facilities were calculated by overlaying the addressable structures with the SFHA as shown in the FIRM data. Similarly, the estimated population in the SFHA was calculated by overlaying the centroids of Census blocks with the SFHA; while clearly an estimate, using the block centroid helps to minimize overestimation of flood-prone populations. The results of this analysis are also shown on the map in Figure 3.3.5-2.

Overall, only an estimated 0.67% of the addressable structures and 1.42% of the population in Charles County are located in 1%-annual-chance flood zone and are most at risk to the impacts of flooding. All of these structures are located in unincorporated areas of Charles County. As shown in table 3.3.5-12, the majority of structures located in the SFHA were residential (256), followed by commercial land use types (65). There were also six critical facilities located in the SFHA, all of which were located in unincorporated areas of the County. However, all of these critical facilities also had water-related uses, including dams, pump stations, and wells (see Table 3.3.5-10).

Table 3.3.5-10: Critical Facilities located in the SFHA		
CF NAME	CF TYPE	COMMUNITY
Trinity Church	Dams	Charles County Unincorporated Areas
Lake Jameson	Dams	Charles County Unincorporated Areas
Gilbert Run	Dams	Charles County Unincorporated Areas
Rt 5 Pump Station	Pump Stations	Charles County Unincorporated Areas
Cobb Island Pump Station	Pump Stations	Charles County Unincorporated Areas
Well Lot	Wells	Charles County Unincorporated Areas

There are also 10 historic buildings or sites, 5 historic districts, and one historic skipjack on the National Register of Historic Places located in the SFHA. Additionally, there are 95 historic properties on the Maryland Inventory of Historic Properties located in the SFHA, several of which are bridges. More information about the vulnerability of historic and cultural resources to flood can be found in Section 4.3.1.

In summary, the vast majority of structures, populations, and critical facilities are located outside of the SFHA. This can be attributed to Charles County's aggressive floodplain management practices and smart siting of critical facilities and infrastructure.

Table 3.3.5-11: Community Flood Vulnerability

MUNICIPALITY	TOTAL STRUCTURES	TOTAL STRUCTURES IN SFHA	PERCENT STRUCTURES IN SFHA	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES IN SFHA	PERCENT CRITICAL FACILITIES IN SFHA	TOTAL ESTIMATED 2010 POPULATION	POPULATION IN SFHA	PERCENT POPULATION IN SFHA
Charles County Unincorporated Areas	61,656	450	0.73%	573	6	1.05%	134,384	2,076	1.54%
Town of Indian Head	1,680	0	0.00%	23	0	0.00%	3,833	0	0.00%
Town of La Plata	4,126	0	0.00%	82	0	0.00%	8,321	0	0.00%
Village of Port Tobacco	11*	0	0.00%	0	0	0.00%	13	3	23.08%
Total	**67,473**	**450**	**0.67%**	**678**	**6**	**0.88%**	**146,551**	**2,079**	**1.42%**

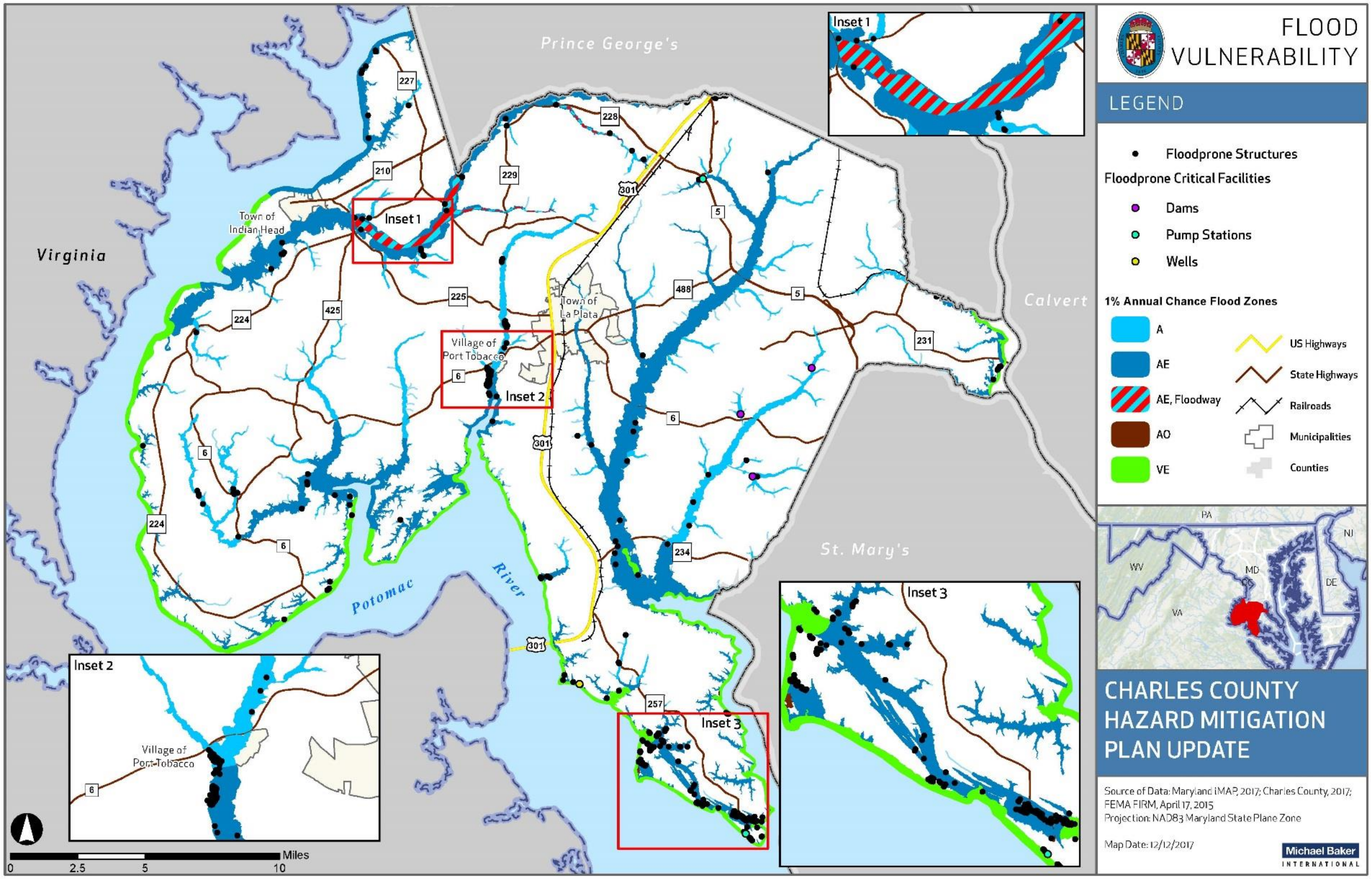
** The Village of Port Tobacco noted that there are 22 structures in the jurisdiction; however, this analysis was conducted with GIS data which only included 11.*

Table 3.3.5-12: Structures vulnerable to flooding (in SFHA) by municipality and land use type.

MUNICIPALITY	TOTAL STRUCTURES	AGRICULTURE	COMMERCIAL	EDUCATION	FOREST	INDUSTRIAL	OPEN AND VACANT LAND	OTHER	RESIDENTIAL	WATER	TOTAL STRUCTURES IN SFHA
Charles County Unincorporated Areas	61,656	14	65	1	53	3	3	1	256	54	450
Town of Indian Head	1,680	0	0	0	0	0	0	0	0	0	0
Town of La Plata	4,126	0	0	0	0	0	0	0	0	0	0
Village of Port Tobacco	11	0	0	0	0	0	0	0	0	0	0
Total	**67,473**	**14**	**65**	**1**	**53**	**3**	**3**	**1**	**256**	**54**	**450**

** The Village of Port Tobacco noted that there are 22 structures in the jurisdiction; however, this analysis was conducted with GIS data which only included 11.*

Figure 3.3.5-6: Structures and Critical Facilities Located in the SFHA



Coastal areas of Charles County may be prone to more significant flooding than areas further inland. Figure 3.3.5-7 shows coastal flood depths for the 1%-annual-chance-flood event. As shown in the map, coastal areas along the Potomac and much of the County's coastline have the potential to experience flood depths of over 9 feet during a 1%-annual-chance-flood event. Please note that this map only depicts flood depths for coastal areas.

Similarly, Figure 3.3.5.8 depicts the potential sea level rise impacts on Charles County, and shows that some areas have the potential to experience 5 to 10 foot inundation. Sea level rise impacts are projected to have the greatest impacts to areas surrounding the Mattawoman Creek, the Nanjemoy Creek, the Potomac River, and the Wicomico River.

Charles County also determined the types and numbers of potential assets exposed to flooding using a loss estimation model called Hazus, which was developed by FEMA and is a nationally applicable standardized methodology that estimates potential losses from earthquakes, hurricanes, floods, and tsunamis. Hazus uses state-of-the-art GIS software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of earthquakes, hurricanes, floods, and tsunamis on populations. Estimating losses is essential to decision-making at all levels of government and provides a basis for developing mitigation plans and policies, emergency preparedness, and response and recovery planning.

The potential predictive loss estimate data for the 2018 HMP Update was completed using an enhanced Hazus analysis for floods. As opposed to basic analysis using only default data, this enhanced analysis incorporates both up-to-date and specific data for inclusion in the hazard models. The enhanced data incorporated into this HMP update include:

- Updated demographic data from the 2010 Census;
- Dasymetric Census blocks to better attribute areas of population geographically within the block; and
- A user-delineated 100-year depth grid derived for Charles County from the effective FIRM data.

Using these datasets in Hazus Version 3.2, total economic losses from a 1%-annual-chance flood in Charles County are estimated at $67.27 million. Residential occupancies make up 76.28 percent of the total estimated building-related losses, while commercial buildings make up 16.96 percent of the losses. According to the model, no critical facilities would be damaged by to the flooding. Figure 3.3.5-9 shows the distribution of building-related losses by census block across Charles County.

Figure 3.3.5-7: Charles County Coastal Flood Depths

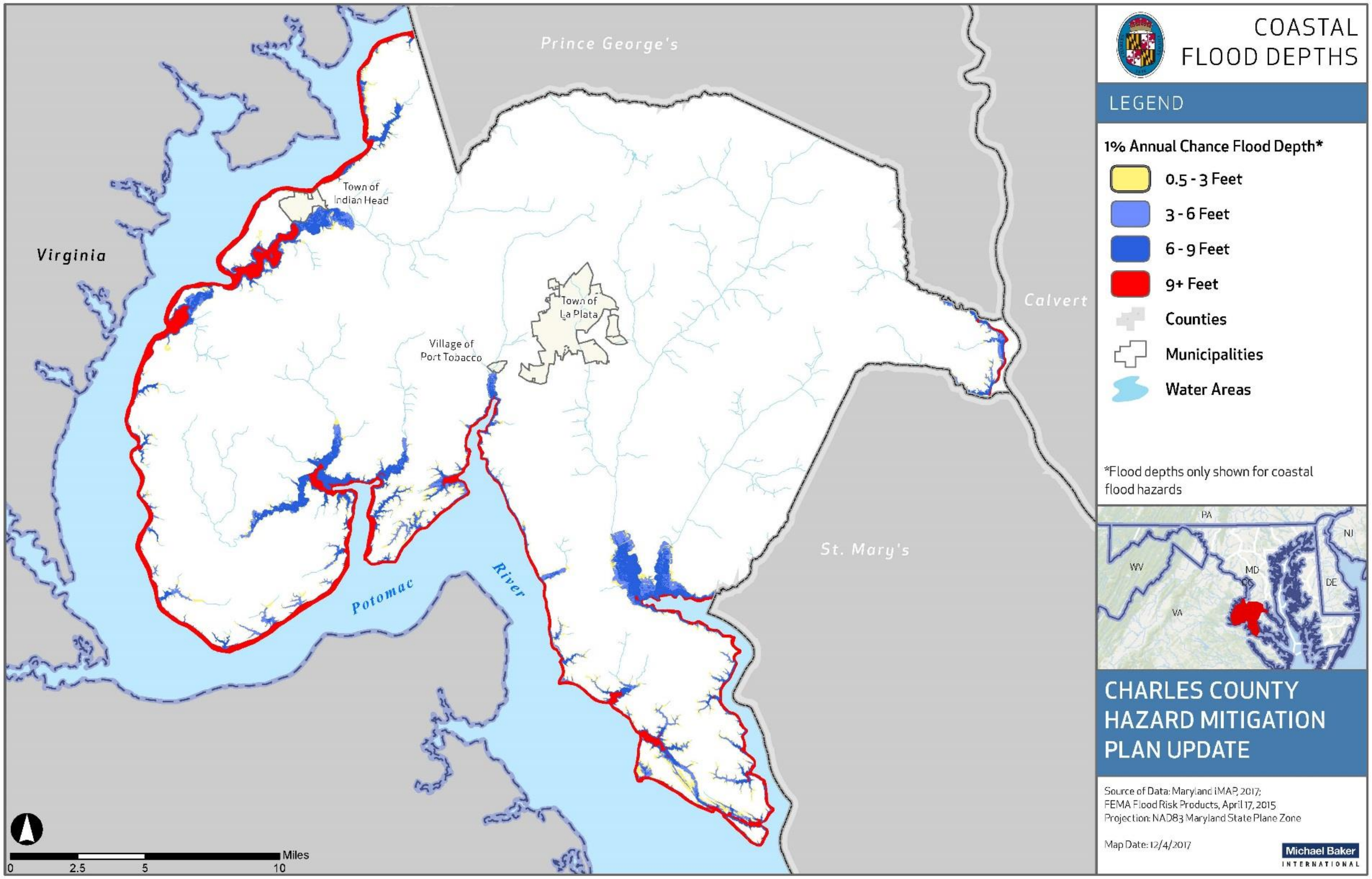


Figure 3.3.5-8: Charles County Sea Level Rise Vulnerability

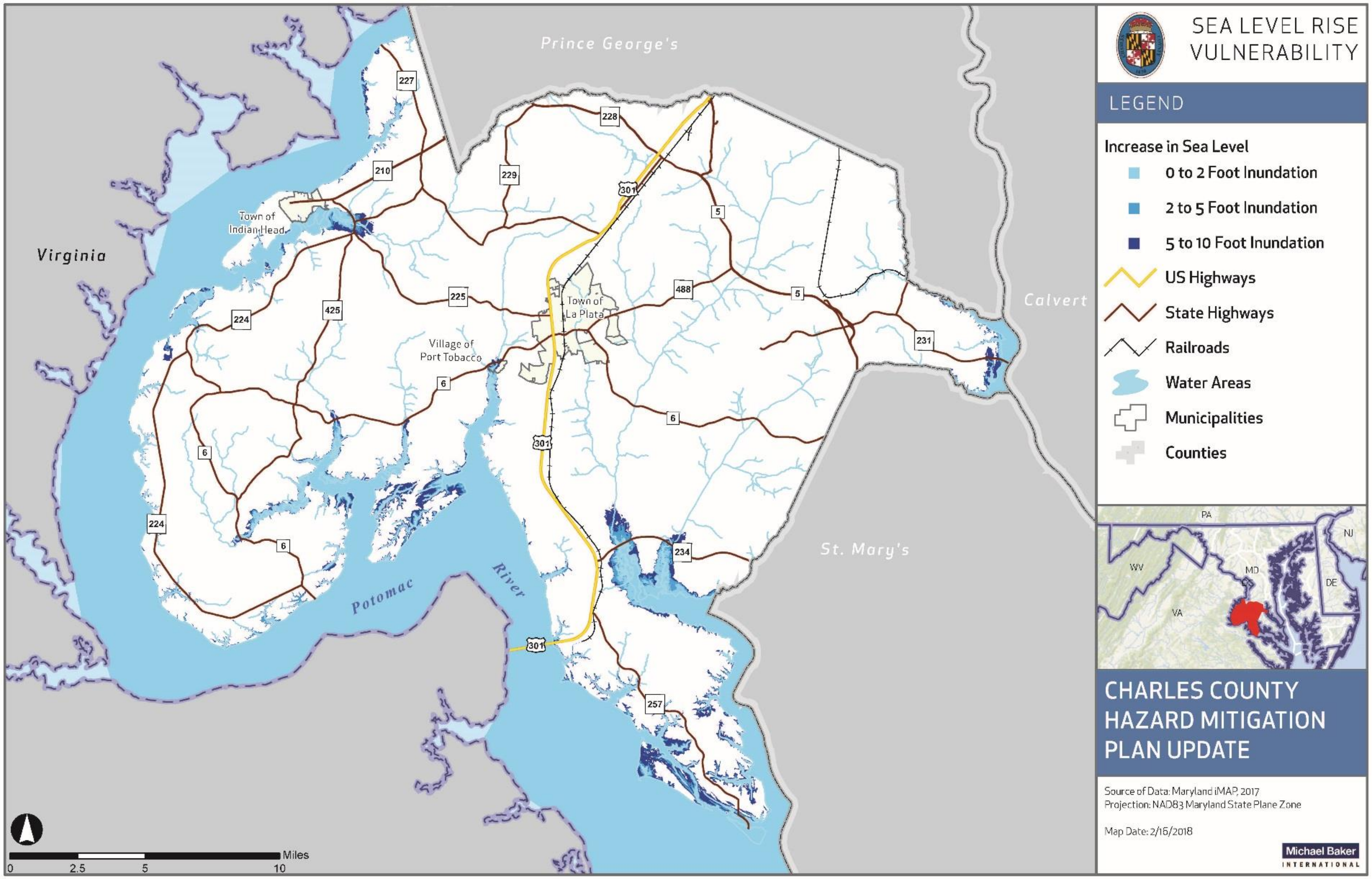


Figure 3.3.5-9: Charles County Hazus Losses

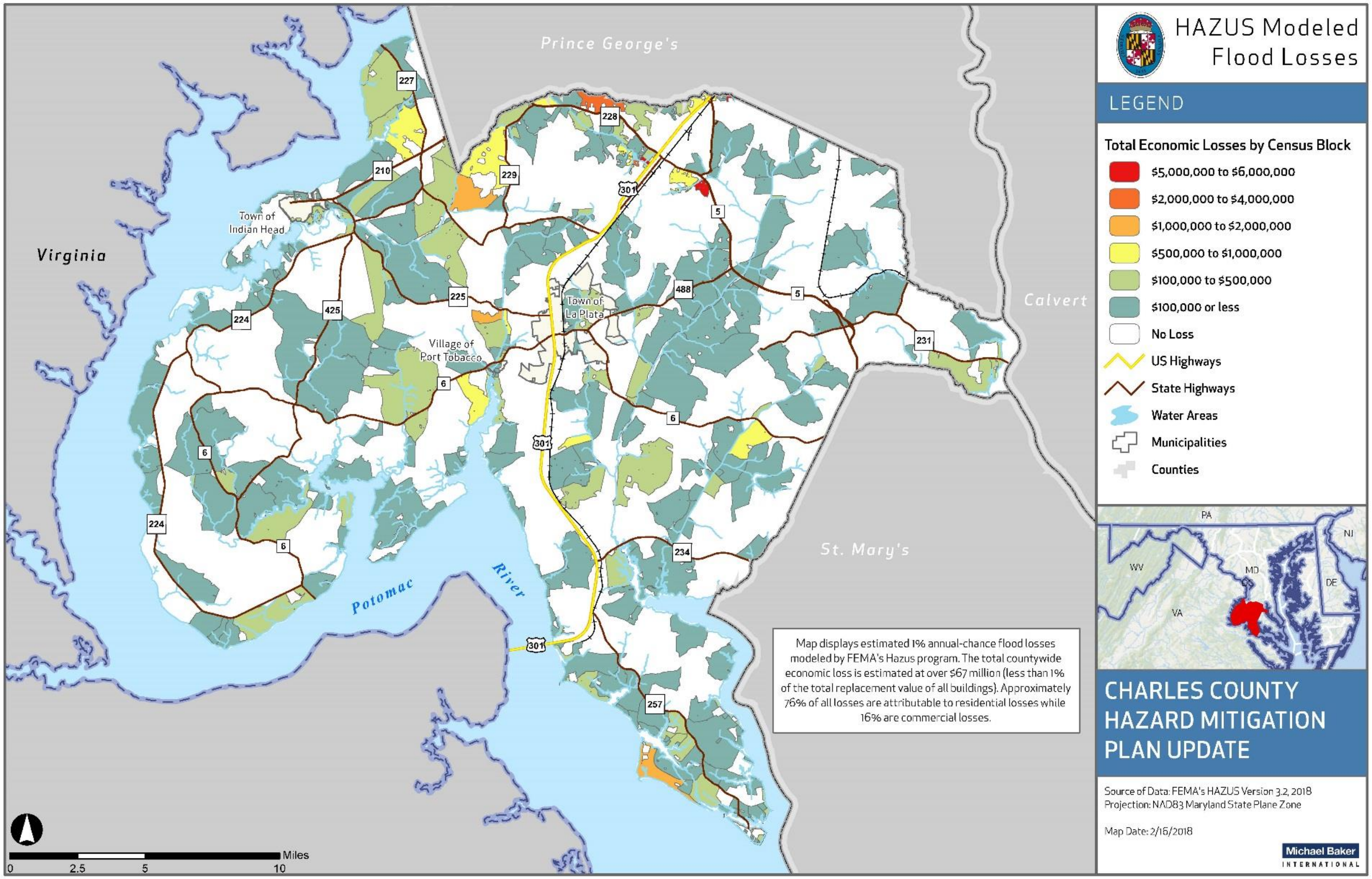


Table 3.3.5-13 summarizes total replacement value of buildings in the region by occupancy type and the estimate replacement value, while Table 3.3.5-14 estimates the expected damage by general occupancy for the flood scenario.

Table 3.3.5-13: Building Exposure by Occupancy Type for the Study Region

OCCUPANCY	EXPOSURE ($1,000)	PERCENT OF TOTAL
Residential	$17,919,835	87.2%
Commercial	$1,840,063	9.0%
Industrial	$313,755	1.5%
Agricultural	$56,267	0.3%
Religion	$180,668	0.9%
Government	$125,664	0.6%
Education	$121,540	0.6%
Total	**$20,557,792**	**100.0%**

Table 3.3.5-14: Building Exposure by Occupancy Type for the Flood Scenario

OCCUPANCY	EXPOSURE ($1,000)	PERCENT OF TOTAL
Residential	$6,019,871	87.5%
Commercial	$587,901	8.5%
Industrial	$101,578	1.5%
Agricultural	$38,011	0.6%
Religion	$51,932	0.8%
Government	$26,539	0.4%
Education	$53,808	0.8%
Total	**$6,879,640**	**100%**

Hazus also estimates that 3,158 tons of debris would be generated by the flood scenario, which would require 126 truckloads (25 tons per truck) to remove the debris generated. Additionally, it is estimated that 590 people would be seeking short-term shelter, and 473 households would be displaced as a result of the flood event.

For more details on the Hazus methodology used and additional results reports, see Appendix F – Hazus Methodology and Results Report.

3.3.5.5 Jurisdictional Differences

As shown in Tables 3.3.5-11 and 3.3.5-12, the unincorporated areas of Charles County are at the highest risk to flooding. For areas with higher populations, significant flooding will have a greater impact because there is a greater exposure of people and property to floodwaters. Also, higher magnitude flooding in the County produces a greater need for evacuation and emergency response. Bennsville, Waldorf, and Issue, all of which are in the unincorporated areas of Charles County, are at a greater risk to experiencing potential losses from flooding as shown by results of the Hazus analysis.

3.3.5.6 Land Use and Development Trends

Charles County recently received updated FIRMs in 2013 and 2015 and subsequently adopted an updated floodplain ordinance. Therefore, it is unlikely that new development would occur in areas prone to flooding without careful consideration of flood hazards during the development review process. However, as the County's population continues to grow, flood impacts could potentially be more widespread. In communities with higher populations, significant flood or flash flood events will have a higher impact because there is a greater exposure of people and property to floodwaters. Also, higher magnitude flooding in the County produces a greater need for evacuation and emergency response.

While flooding remains a likely occurrence throughout the identified flood hazard areas of Charles County, smaller floods caused by heavy rains and inadequate drainage capacity will be more frequent, but not as costly as the large-scale floods which may occur at much less frequent intervals. While the potential for flood is always present, Charles County current policies and regulations for development will help reduce the potential for future damages due to floods.

3.3.6 Hurricane, Tropical Storm, Nor'easter

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Natural	2	3	4	1	2	**2.6**
MODERATE RISK (2.0 – 2.9)						

3.3.6.1 Location, Extent, and Range of Magnitude

Coastal hazards take many forms, ranging from storm systems like hurricanes, tropical storms, and Nor'easters that can cause storm surge inundation and heavy precipitation that may lead to flash flooding and exacerbation of shoreline erosion. These events may also contribute to longer term hazards such as sea level rise.

Tropical cyclones, a general term for tropical storms and hurricanes, are low pressure systems that usually form over the tropics. These storms are referred to as cyclones due to their rotation. Tropical cyclones are among the most powerful and destructive meteorological systems on earth. Their destructive phenomena include very high winds, heavy rain, lightning, tornadoes, and storm surge. As tropical storms move inland, they can cause severe flooding, downed trees and power lines, and structural damage.

There are three categories of tropical cyclones:

1. **Tropical Depression:** maximum sustained surface wind speed is less than 39 mph.
2. **Tropical Storm:** maximum sustained surface wind speed from 39-73 mph.
3. **Hurricane:** maximum sustained surface wind speed exceeds 73 mph.

Once a tropical cyclone no longer has tropical characteristics it is then classified as an extratropical system. Most Atlantic tropical cyclones begin as atmospheric, as easterly waves propagate off the coast of Africa and cross the tropical North Atlantic and Caribbean Sea. When a storm starts to move toward the north, it begins to leave the area where the easterly trade winds prevail, and enters the temperate latitudes where the westerly winds dominate. This produces the eastward curving pattern of most tropical storms that pass through the Mid-Atlantic region. When the westerly steering winds are strong, it is easier to predict where a hurricane will go. When the steering winds become weak, the storm follows an erratic path that makes forecasting very difficult.

Tropical storms and hurricanes are accompanied by a storm surge, an abnormal local rise in sea level. The storm surge is caused by the difference in wind and barometric pressure between a tropical system and the environment outside the system. The end result is that water is pushed onto a coastline. The height of the surge is measured as the deviation from mean sea level and can reach over 25 feet in extreme circumstances. The most devastating storm surges occur just to the right of the eye of a land falling hurricane. For coastal areas, the storm surge is typically the most dangerous and damaging aspect of the storm.

Howling winds associated with Nor'easters also have the potential to produce significant storm surge, similar to that of a Category One hurricane. In addition, these types of storms can also produce wind gusts to near hurricane force as well as flooding rain and crippling snowfall. The wintry impacts of Nor'easters are discussed in greater detail in Section 3.3.7: Severe Winter Storms. The Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model is used to evaluate the potential impact of storm surge. Emergency managers use data from SLOSH to identify at-risk populations and determine evacuation areas. Storm surges also affect tidal rivers and creeks, potentially increasing evacuation areas.

Hurricanes are categorized according to the Saffir/Simpson scale with ratings determined by wind speed and central barometric pressure. Hurricane categories range from One through Five, with Category Five being the strongest (winds greater than 155 mph). A hurricane watch is issued when hurricane conditions could occur within the next 36 hours. A hurricane warning indicates that sustained winds of at least 74 mph are expected within 24 hours or less. The National Weather Service (NWS) National Hurricane Center defines June 1 through November 30 as the Atlantic hurricane season. September is typically the most active month for tropical cyclones in Maryland.

The Saffir/Simpson scale, shown in Table 3.3.6-1, was developed in 1971 by Herbert Saffir and Dr. Robert Simpson as a way to classify hurricanes. The scale rates the intensity of hurricanes based on wind speed and barometric pressure measurements. The scale gives an indication of the potential flooding and wind damages associated with each hurricane category. While major hurricanes comprise only 20% of all tropical cyclones making landfall, they account for over 70% of the damage in the United States.

Table 3.3.6-1: Saffir-Simpson Scale Categories with Associated Wind speeds and Damages (NHC, 2012)

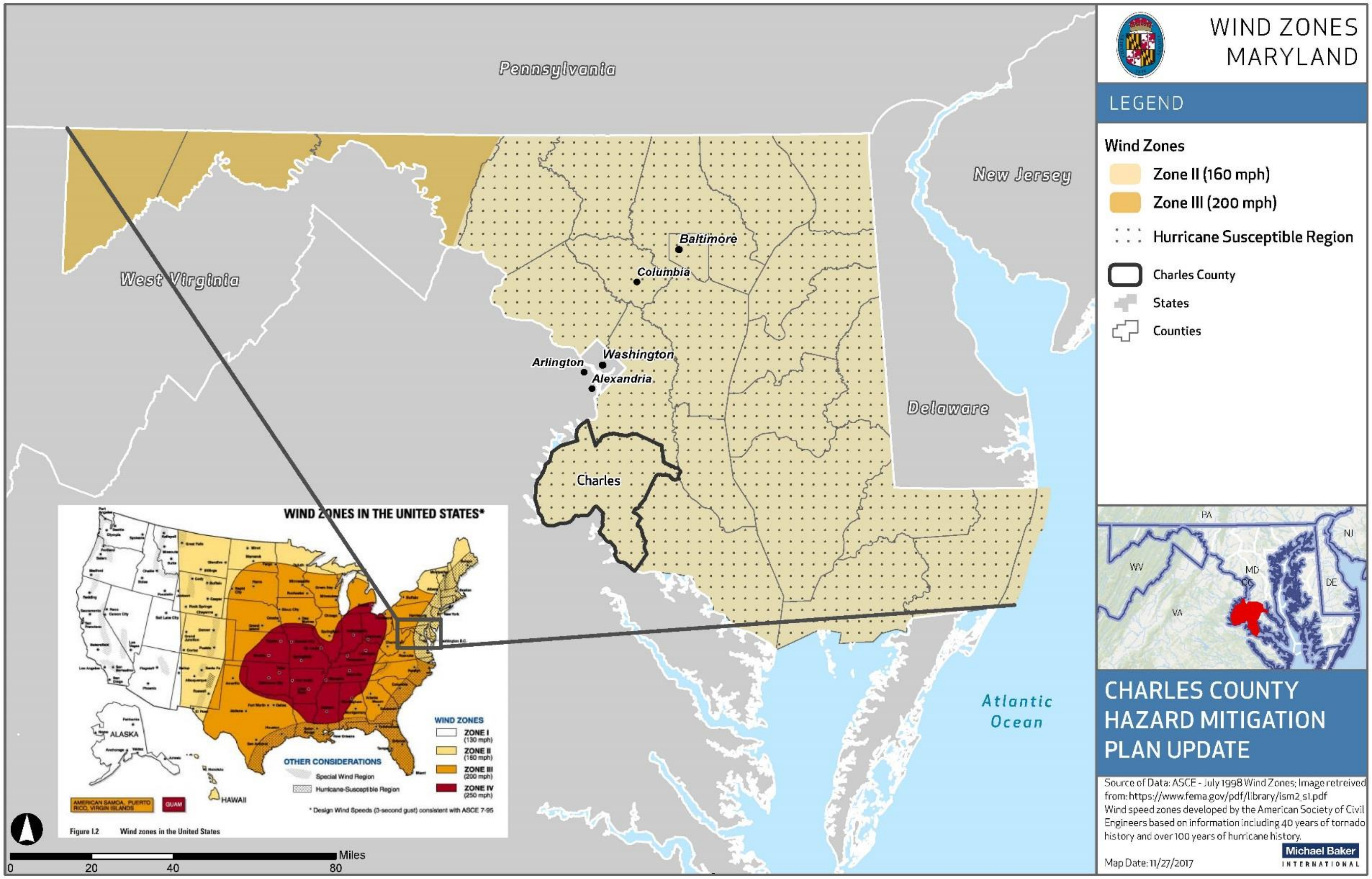
STORM CATEGORY	WIND SPEED (MPH)	DESCRIPTION OF DAMAGE
1	74-95	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111-129	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	130-156	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	> 157	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles

Table 3.3.6-1: Saffir-Simpson Scale Categories with Associated Wind speeds and Damages (NHC, 2012)		
STORM CATEGORY	WIND SPEED (MPH)	DESCRIPTION OF DAMAGE
		will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

All of Charles County could be affected by a hurricane or a tropical storm. Since these events can disrupt power and inundate roads, tropical storms 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.

Figure 3.3.6-1 depicts the wind zone for Charles County. The wind zones were established by the American Society of Civil Engineers based on information which includes 40 years of tornado history and over 100 years of hurricane history. Charles County falls into within Zone II. Shelters and critical facilities should be able to withstand a 3-second gust of up to 160 mph, regardless of whether the gust is the result of a tornado, coastal storm, or windstorm event. Therefore, these structures should be able to withstand the wind speeds experienced in a Category 5 event.

Figure 3.3.6-2: Wind Zones and Hurricane Susceptible Region in Maryland



3.3.6.2 Past Occurrence

Since 1950, there have been only 3 tropical storms that have affected Charles County. Table 3.3.6-2 gives a brief synopsis of those three events, according to the NOAA's Storm Events.

Table 3.3.6-1: Hurricane and Tropical Storm Events in Charles County since 1950 (NOAA, 2017)

DATES	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
9/16/1999	0	0	$25,000	0
9/18/2003	0	41	$5,700,000	$10,000
8/11/2011	0	0	$1,300,000	0
Total	**0**	**41**	**$7,025,000**	**$10,000**

On September 16, 1999, Hurricane Floyd hit Maryland and resulted in property damage of approximately $200 million, roughly $25,000 of which occurred in Charles County. 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. A total of 5 to 8 inches fell across Baltimore, Prince George's, and Charles Counties. The amount of damage that 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. In Charles County, over 20 roads were closed by flooding. Several trees and power lines were downed, resulting in 5,000 power outages.

On September 18, 2003, Charles County was struck by Hurricane Isabel. Initially Isabel was identified as a Category 2 hurricane that turned into a tropical storm by the time it struck Charles County. In Benedict, historic buildings along the Patuxent River sustained flooding from the storm surge, including some of the same houses severely damaged during the La Plata tornado in 2002. Cobb Island, a waterfront community, was hit by storm surge. This event caused approximately $5,700,000 in property damage and $10,000 in crop damage throughout the County.

On August 11, 2011, Charles County and many other counties in Maryland were hit by Hurricane Irene. Maximum sustained winds were about 80 mph when Hurricane Irene first made landfall near Ocean City, indicating that it was a Category One hurricane at landfall. The hurricane produced tropical storm conditions for Charles County and the rest of the state. There was no reported crop damage, but over $1 million in property damage was recorded.

Although NOAA's Storm Events database only lists these three events for Charles County, the County may have been impacted by other hurricane and tropical storm events that have affected the State of Maryland. These additional events are listed below:

August 27, 1667 - Unnamed Hurricane: A strong hurricane ripped through the Mid-Atlantic region, causing 1667 to be known as "the Year of the Hurricane". A government report noted, "A mighty wind...destroyed four-fifths of (our) tobacco and corn and blew down in two hours fifteen thousand houses in Virginia and Maryland." Several separate accounts of the storm describe the great devastation. This was known as a benchmark storm for many generations.

October 15, 1954 - Hurricane Hazel: Hurricane Hazel made landfall as a Category 4 hurricane near the North Carolina-South Carolina border on October 15. Hurricane-force gusts swept the eastern half of Maryland, while heavy rains pounded the west. Washington National Airport reported a record sustained wind of 78 mph with gusts up to 98 mph. Gusts near 100 mph were commonplace throughout the Chesapeake Bay region and on the Eastern Shore. Severe flooding occurred along the bay and its tidal tributaries, and flash flooding plagued western Maryland, where 3-6 inches of rain fell. Generally, less than 2 inches of rain fell in the eastern half of the state.

August 12 and 18, 1955 - Hurricanes Connie and Diane: Hurricanes Connie and Diane both passed over Maryland as tropical storms within several days of each other, on August 12 and 18, respectively. The rains from Connie set the stage for the devastating floods caused by Diane, which poured 10-20 inches of rain on the already-soaked region. Major flooding occurred in central Maryland, particularly along the Potomac River. Strong gales from Connie sunk the tour schooner Levin J. Marvel, about 20 miles south of its home port of Annapolis, and fourteen passengers drowned.

June 21-23, 1972 - Hurricane Agnes: Hurricane Agnes moved through the Atlantic past Maryland as a tropical storm on June 21-23. Widespread and in some places record flooding wrought one of the state's most destructive natural disasters. In the tributaries on the north side of the Potomac River, from the Conococheague Creek at Fairview, Maryland down to Rock Creek at Washington, DC, floods in excess of the 100-year frequency level were observed. Many roads were closed, particularly in central Maryland, and thousands of evacuations occurred. The event proved to be an ecological calamity for the Chesapeake Bay. The damage in Maryland was in excess of $1.1 million, and there were 19 deaths.

July 13, 1996 - Hurricane Bertha: Hurricane Bertha moved across the Lower Maryland Eastern Shore on July 13th. The highest sustained wind speed recorded was 23 mph at Salisbury, with gusts up to 63 mph at Ocean City. One confirmed tornado was spawned by the hurricane near Madison in Dorchester County. Numerous trees and power lines were blown down and resulted in scattered property damage and power outages. Rainfall amounts generally ranged from to 5.0 inches and caused some street flooding. Property damages of $100,000 and crop damages of $15,000 occurred.

September 6, 1996 - Tropical Storm Fran: Spiral bands associated with Hurricane Fran affected the Lower Maryland Eastern Shore during Friday, September 6th. The highest sustained wind speed recorded was 22 mph at Salisbury with gusts of 35 mph. A storm surge of 4 to 6 feet inundated portions of the communities of Taylors Island, Hoopers Island, and Madison in Dorchester County along the Chesapeake Bay. Many roads were flooded with some homes receiving water damage at the time of high tide. Dorchester, Wicomico, Somerset, and Worcester counties were affected, and property damages reached $1 million. Storm winds channeled water up the Chesapeake Bay and its main tributaries, which became a small-scale storm surge, causing $1.6 million in property damages and $5,000 in crop damages in central Maryland.

October 8, 1996 - Tropical Storm Josephine: Remnants of Tropical Storm Josephine moved quickly up the East Coast during Tuesday, October 8th, affecting the Lower Maryland Eastern Shore. The storm produced 1.5 to 3.5 inches of rain resulting in flooding of several roads. The storm caused $100,000 in damages.

September 16, 1999 - Hurricane Floyd: Hurricane Floyd moved north-northeast across extreme southeast Virginia and reached Maryland near Ocean City by evening on the 16th. Hurricane Floyd was a Category 1 hurricane as it crossed the Wakefield WFO county warning area. The storm surge caused tides two to three feet above normal throughout central Maryland. Tropical storm force wind gusts occurred in the northwest quadrant of the storm over portions of the Lower Maryland Eastern Shore. Property damages of over $1 million and crop damages of $575,000 occurred.

September 18, 2003 - Hurricane Isabel: Hurricane Isabel had been downgraded to a tropical storm by the time it reached Maryland, but it still caused significant damage in the state. Isabel's eye tracked well 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 of the Chesapeake Bay and along the tidal tributaries of the Potomac, Patuxent, Patapsco and other smaller rivers experienced a storm surge that reached 5 to 9 feet above normal tides. Over 2000 people were evacuated from their homes. Many buildings were destroyed and the Lower Maryland East Shore suffered the worst power outages in history. The storm caused one fatality, 200 injuries, $530 million in property damages, and $190,000 in crop damages. Counties affected included Anne Arundel, Calvert, Charles, Harford, Baltimore, Prince George's, and St. Mary's.

September 1, 2006 - Tropical Storm Ernesto: Moderate coastal flooding occurred due to the storm surge from the remnants of Tropical Storm Ernesto. The tide crest at Annapolis was 3.56 MLLW late Friday. In Charles County, mandatory evacuations were ordered due to the flooding, with many roads flooded. Property damage reached $50,000.

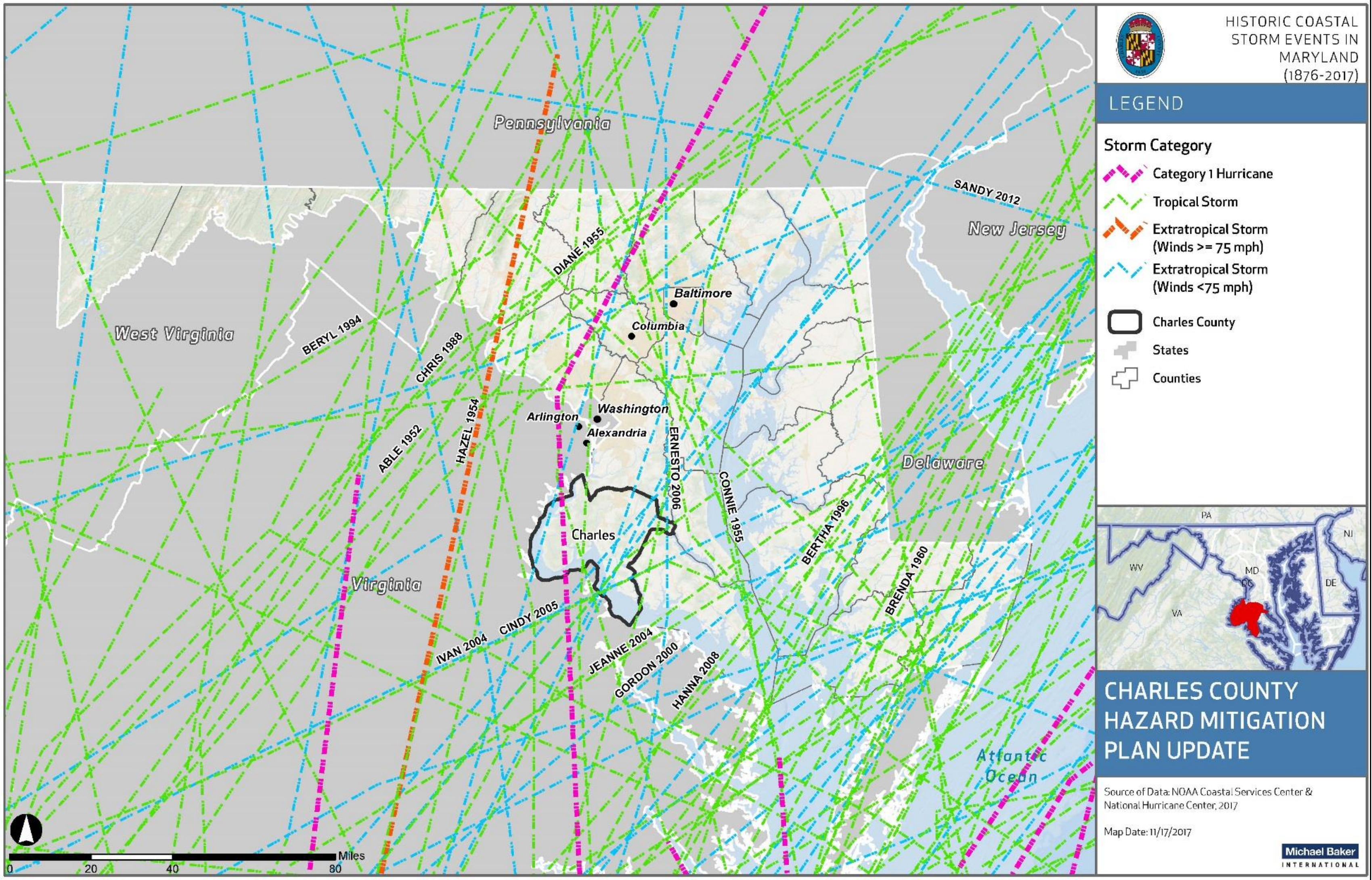
September 6, 2008 - Tropical Storm Hanna: Tropical Storm Hanna brought heavy rain, strong winds and some tidal flooding to the Eastern Shore during the day and into the evening of the 6th. Maximum sustained winds reached 50 mph. Tree damage was sustained throughout much of the state, and many roads were closed due to trees down.

September 6-9, 2011 – Tropical Storm Lee: On September 1st, 2011 Tropical Storm Lee developed in the northern Gulf of Mexico and made landfall in Louisiana on September 4th. The storm moved northeast towards the Tennessee Valley before coming extratropical. On Wednesday morning, September 7th, a torrential rainband set up above Charles County, stretching all the way to Baltimore. Rain accumulation reached 2 to 3 inches per hour, resulting in numerous home evacuations, rescues, road closures, flooding, and property damage. A Disaster Declaration was declared on October 5, 2011 for the entire State. Central Charles County and Ellicott City in Howard County were hit particularly hard (NWS, 2011). The County experienced $1,270,422.02 in reimbursable damages, including over $1 million in Public Assistance (FEMA, 2018).

September 2, 2016 - Tropical Storm Hermine: Tropical Storm Hermine affected the Southern Coast and Lower Maryland Eastern Shore areas. The affected counties were Dorchester, Wicomico, Somerset, and inland portions of Worchester as well as Maryland’s Beaches. Tropical Hermine produced wind gusts, minor coastal flooding, and heavy rainfall for nearly three days.

Figure 3.3.6-2 shows hurricane tracks that have crossed Charles County and the rest of Maryland.

Figure 3.3.6-2: Historic Coastal Storm Events in Maryland



3.3.6.3 Future Occurrence

Although hurricanes and tropical storms can cause flood events consistent with 100- and 500- year levels, their probability of occurrence is measured relative to wind speed. Table 3.3.6-4 shows the probability of winds that reach the strength of tropical storms and hurricane conditions in Charles County and surrounding areas based on a statistical sample region of more than 30,000 square miles over a period of 46 years.

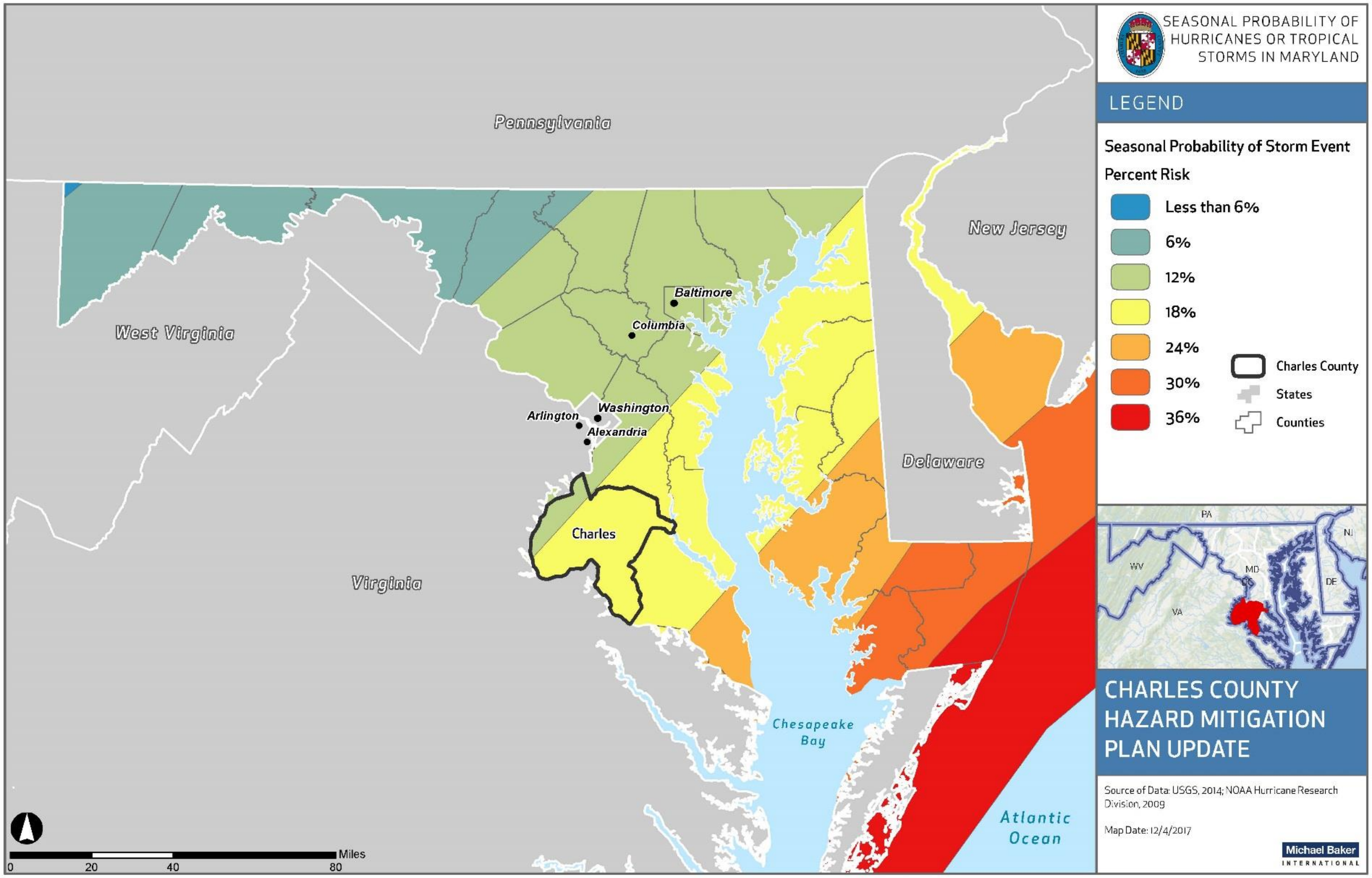
Table 3.3.6-4: Annual probability of tropical storm and hurricane strength wind speeds for Charles County (ASCE, 2003)

WIND SPEED (MPH)	CORRESPONDING SAFFIR-SIMPSON TROPICAL STORM/HURRICANE CATEGORIES	ANNUAL PROBABILITY OF OCCURENCE
45 - 77	Tropical Storms and Category 1 Hurricanes	91.59%
78 - 118	Category 1 to 2 Hurricanes	8.32%
119 - 138	Category 3 to 4 Hurricanes	0.0766%
139 - 163	Category 4 to 5 Hurricanes	0.0086%
164-194	Category 5 Hurricanes	0.00054%
195 +	Category 5 Hurricanes	0.00001%

Table 3.3.6-4 includes wind speeds for all types of storms and is not specific to cyclonic winds. In Charles County and surrounding areas, the annual probability for winds that equal the strength of tropical storms (over 39 mph) is over 90 percent. The probability for winds at category 1 or 2 hurricane strength (78-118 mph) is greater than 8% in any given year. Combing this information with that in Table 3.3.6-1, these wind speeds correspond to minimal or moderate expected damages. The annual probability of winds exceeding 118 mph is less than 0.1 %.

The map included as Figure 3.3.6-3 shows the chances of a tropical storm or hurricane affecting a given area of Maryland during the entire Atlantic hurricane season spanning from June to November. Note that this figure does not provide information on the probability of various storm intensities. However, based on historical data, this map reveals there is between a 12% to an 18% chance of Charles County experiencing a tropical storm or hurricane event between June and November of any given year, depending on the location within the County. The probability of future Hurricane, Tropical Storms, and Nor'easters impacting the County can be considered *possible* (2 of 4) according to the Risk Factor Methodology.

Figure 3.3.6-3: Seasonal Probability of Hurricanes or Tropical Storms affecting Charles County



3.3.6.4 Vulnerability Assessment

A vulnerability assessment for hurricanes and tropical storms focuses on the impacts of flooding and severe wind. Charles County is vulnerable to the impact of flooding and severe wind caused by these events. Historic data indicates that while storm tracks occasionally track over Charles County, impacts from associated rain can be felt in low-lying communities that face similar vulnerability from flooding events. A detailed assessment of Charles County's flood-related vulnerability is addressed in Section 3.3.5, while its vulnerability to wind damage is addressed in Section 3.3.4. Charles County may also be vulnerable to severe winter weather impacts caused by Nor'easters, as evaluated in Section 3.3.7.

3.3.6.5 Jurisdictional Differences

All of Charles County could be affected by a hurricane or a tropical storm. Since these events can disrupt power and inundate roads, tropical storms 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. More densely populated communities that are in close proximity to flood prone watercourses such as Indian Head, Port Tobacco, and unincorporated areas of the County are particularly vulnerable. Additionally, as shown in Figure 3.3.6-3, the northwestern section of the County is less likely to be impacted by hurricane or tropical storm events based on the seasonal probability of a storm event.

3.3.6.6 Land Use and Development Trends

The type and age of development play a role in vulnerability to hurricanes and tropical storms. In general, concrete, brick, and steel-framed structures tend to fare better than older, wood-framed structures or manufactured homes. As Charles County continues to grow and develop, it is therefore important to ensure that all development is built to code to withstand impacts from flooding and severe wind associate with hurricanes and other tropical storms.

3.3.7 Severe Winter Storms

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Natural	3	1	4	1	3	**2.4**
MODERATE RISK (2.0 – 2.9)						

3.3.7.1 Location, Extent, and Range of Magnitude

Charles County has been impacted by varying degrees of winter weather over the last century; however; the occurrence of severe winter weather in the County is relatively infrequent, even during winter months. Severe winter weather can cause hazardous driving conditions, communication and electrical power failure, community isolation, and can adversely affect business continuity. This type of severe weather may include one or more of the following winter factors:

Blizzards: As defined by the NWS, blizzards are a combination of sustained winds or frequent gusts of 35 mph or greater and visibilities of less than a quarter mile from falling or blowing snow for 3 hours or more. A blizzard, by definition, does not indicate heavy amounts of snow, although they can happen together. The falling or blowing of snow usually creates large drifts from the strong winds. The reduced visibilities make travel, even on foot, particularly treacherous. The strong winds may also support dangerous wind chills. Ground blizzards can develop when strong winds lift snow off the ground and severely reduce visibilities.

Heavy snow: Heavy snow may fall in large quantities during winter storms. Six inches or more in 12 hours or eight inches or more in 24 hours constitutes conditions that may significantly hamper travel or create hazardous conditions. The NWS issues warnings for such events. Smaller amounts can also make travel hazardous, but in most cases, only results in minor inconveniences. Heavy wet snow, before the leaves fall from the trees in the fall or after the trees have leafed out in the spring, may cause problems with broken tree branches and power outages.

Ice storms: Ice storms develop when a layer of warm (above freezing), moist air aloft coincides with a shallow cold (below freezing) pool of air at the surface. As snow falls into the warm layer of air, it melts to rain, and then freezes on contact when hitting the frozen ground or cold objects at the surface, creating a smooth layer of ice. This phenomenon is called freezing rain. Similarly, sleet occurs when the rain in the warm layer subsequently freezes into pellets while falling through a cold layer of air at or near the Earth’s surface. Extended periods of freezing rain can lead to accumulations of ice on roadways, walkways, power lines, trees, and buildings. Almost any accumulation can make driving and walking hazardous. Thick accumulations can bring down trees and power lines.

Extreme Cold, in extended periods, although infrequent, could occur throughout the winter months in Charles County. Heating systems compensate for the cold outside. Most people limit their time outside during extreme cold conditions, but common complaints usually include pipes freezing and cars refusing to start. When cold temperatures and wind combine, dangerous wind chills can develop.

Wind chill is how cold it "feels" and is based on the rate of heat loss on exposed skin from wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature, and eventually, internal body temperature. Therefore, the wind makes it feel much colder than the actual temperature. For example, if the temperature is 0°F and the wind is blowing at 15 mph, the wind chill is -19°F. At this wind chill, exposed skin can freeze in 30 minutes. Wind chill does not affect inanimate objects.

Severe winter weather can result in the closing of primary and secondary roads, particularly in rural locations, loss of utility services, and depletion of oil heating supplies. Environmental impacts often include damage to shrubbery and trees due to heavy snow loading, ice build-up, and/or high winds which can break limbs or even bring down large trees. Gradual melting of snow and ice provides excellent groundwater recharge; however, high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flash flooding.

The State of Maryland does have an extensive history of severe winter weather. Maryland's greatest winter storms are the Nor'easters. For nor'easters to occur in Maryland, an arctic air mass would 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; therefore, 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 East 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 on shore and into the bays while dragging more sand away from the beaches.

3.3.7.2 Past Occurrence

Table 3.3.7-1 below represents past reported events of blizzards, heavy snow, winter storms, and winter weather in Charles County from 1950 until 2017. While table 3.3.7-2 depicts past reported events of frost/freeze, ice storms, and sleet from 1950 until 2017. Data for both tables was gathered from the NOAA's Storm Events Database and may not represent all events of severe winter storms in Charles County.

The most damaging severe winter storm event in Charles County took place on February 5, 2010 and resulted in a total of $5,000 in damages. According to NOAA, a total of 24 inches of snow fell Northeast of Bryantown, causing fallen trees and subsequent power outages.

Of the many winter storms to affect Charles County, February 13, 2003 was the most devastating and could be considered a worst-case scenario event statewide. Resulting in the injury of 10 people and over $5.2 million in property damage throughout the Maryland, this complex storm system produced copious amounts of wintry precipitation west of the Chesapeake Bay. After the precipitation came to an end, record-breaking snow and sleet accumulations were reported. Across the extreme southern part of Maryland, accumulations of mainly sleet ranged from 7 to 12 inches. As a general rule, 1 inch of sleet accumulation is equivalent to 3 inches of snow. Therefore, areas that received mainly sleet during this massive winter storm received accumulations around two-thirds less precipitation than areas that had only snow, even though they were impacted by the same storm system. This massive storm took a heavy toll on residents, structures, transportation systems, emergency responders, businesses, livestock, and travelers. A state of emergency was declared by the governor of Maryland and people across the State were ordered to stay off the roads during the height of the storm between the morning of the 16th and the morning of the 17th. In Charles County, the roof of an educational building in Doncaster caved in. Other buildings across the County that sustained structural damage included an auto shop, warehouse, garage, and two stores.

More recently, a blizzard impacts Charles County in January 2016. Snowfall totaled up to 13 inches near Hughesville and 23.5 inches near Waldorf. Gusty winds and low visibility also accompanied the storm, although no damages were reported according to NOAA.

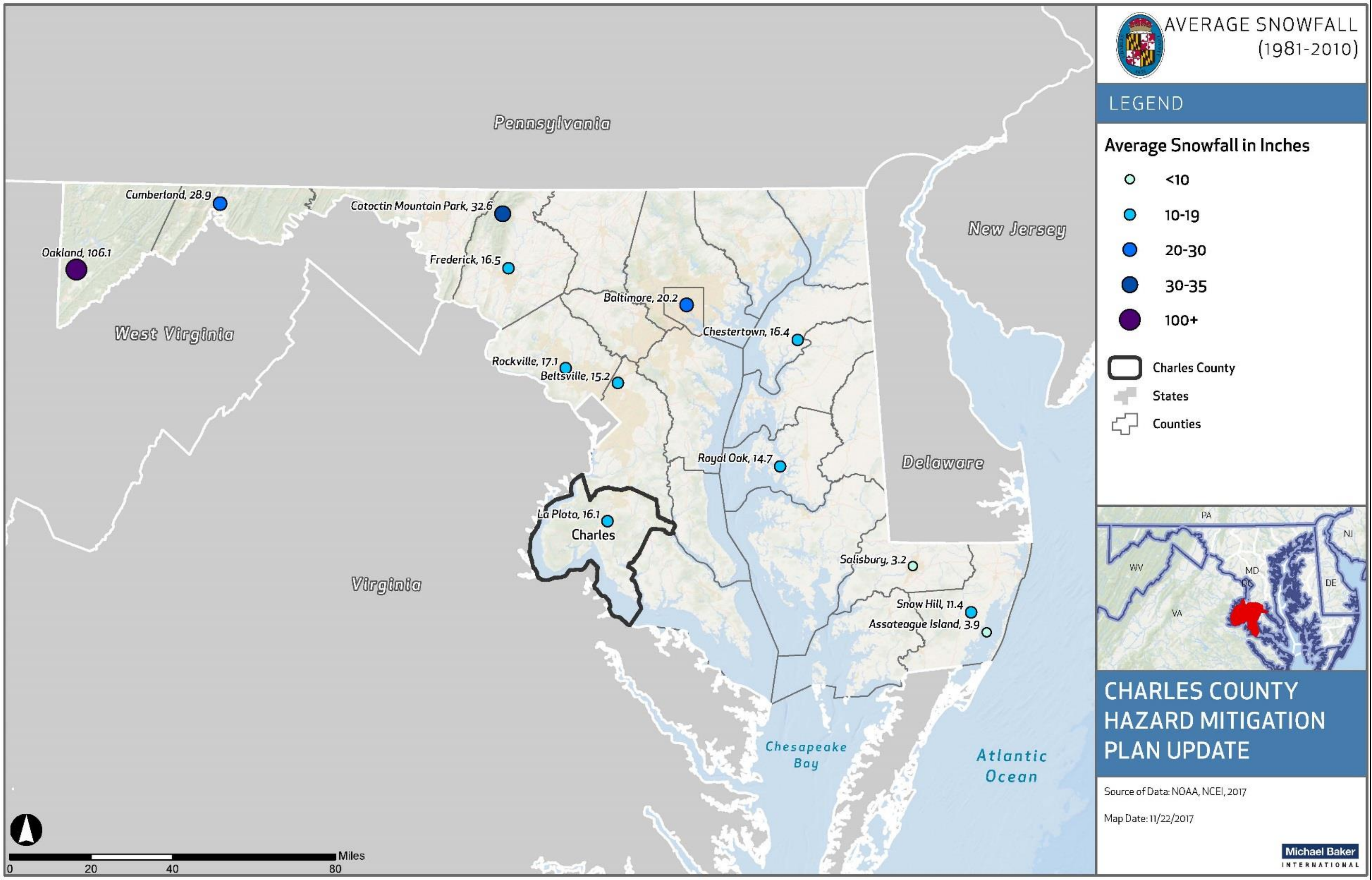
Table 3.3.7-1: Snowstorm Occurrences in Charles County: Blizzards, Heavy Snow, Winter Storm, Winter Weather (NOAA, 2017)

YEAR OF EVENT	NUMBER EVENTS	NUMBER OF INJURIES	NUMBER OF DEATHS	CROP DAMAGE	PROPERTY DAMAGE
1960-2012	69	0	0	$0	$5,000
2013	8	0	0	$0	$0
2014	0	0	0	$0	$0
2015	0	0	0	$0	$0
2016	6	0	0	$0	$0
2017	3	0	0	$0	$0
Total:	**86**	**0**	**0**	**$0**	**$5,000**

Table 3.3.7-2: Ice storm Occurrences in Charles County: Frost/Freeze, Ice Storm, Sleet

YEAR OF EVENT	NUMBER EVENTS	NUMBER OF INJURIES	NUMBER OF DEATHS	CROP DAMAGE	PROPERTY DAMAGE
1960-2012	10	0	0	$0	$0
2013	2	0	0	$0	$0
2014	2	0	0	$0	$0
2015	1	0	0	$0	$0
2016	4	0	0	$0	$0
2017	0	0	0	$0	$0
Total:	**19**	**0**	**0**	**$0**	**$0**

Figure 3.3.7-2: Severe Winter Storms



3.3.7.3 Future Occurrence

The probability of the County and its municipalities experiencing a severe winter storm can be difficult to quantify, but based on historical record of 86 snowstorm events and 19 ice storm events since 1950, it can reasonably be assumed that the probability of future winter storm events is *likely* (3 out of 4) according to the Risk Factor Methodology.

3.3.7.4 Vulnerability Assessment

All assets located in Charles County can be considered at risk to severe winter storms. This includes 100 percent of the County's population, structures, critical facilities, and infrastructure. Damages can primarily occur as a result of cold temperatures, heavy snow or ice, and sometimes strong winds. Due to their regular occurrence, these storms are considered hazards only when they result in damage to specific structures or cause disruption to traffic, communications, electric power, or other utilities.

A winter storm can adversely affect roadways, utilities, business activities, and can cause loss of life, frostbite, and freezing conditions. They can result in the closing of secondary roads, particularly in rural locations, loss of utility services, and depletion of oil heating supplies. Most structures, including the County's critical facilities, should be able to provide adequate protection. However, if there is a heavy snowfall or a significant accumulation over time, the weight of the snow may cause building damage or even collapse. Those facilities with back-up generators are better equipped to handle a severe weather situation should the power go out.

Environmental impacts of winter storms often include damage to shrubbery and trees due to heavy snow loading, ice build-up and/or high winds which can break limbs or even bring down large trees. An indirect effect of winter storms is the treatment of roadway surfaces with salt, chemicals, and other de-icing materials which can impair adjacent surface and ground waters. This is particularly a concern in highly urban areas.

Since winter storms have become a regular occurrence in Charles County, as well as other counties throughout Maryland, strategies have been developed to respond to these events. Snow removal and utility repair equipment is present to respond to typical events. The use of auxiliary heat and electricity supplies such as wood burning stoves, kerosene heaters, and gasoline power generators reduces the vulnerability of specific structures. Locations lacking adequate equipment to protect against cold temperatures or significant snow and ice are more vulnerable to winter storm events. Even for communities that are prepared to respond to winter storms, severe events involving snow accumulations that exceed six or more inches in a twelve-hour period can cause a large number of traffic accidents, interrupt power supply and communications, and cause the failure of inadequately designed and/or maintained roof systems.

Some rural areas of the County may be more susceptible to isolation due to the potential loss of telephone communications and road closings. Power failures and interruption of water supplies are not uncommon from ice storms as well as heavy snow or blizzard conditions. Particular areas of vulnerability include low-income and elderly populations, mobile homes, and infrastructure such as roadways and utilities that can be damaged by such storms. Additionally, low-lying areas of the County can be impacted by flooding related to rapid snow melt.

3.3.7.5 Jurisdictional Differences

While all areas of the County are equally likely to be impacted by a severe winter storm, population and building density has a correlation with vulnerability and potential losses due to this hazard event. Therefore, more developed and populated sections of the County are more vulnerable to the potential impacts of severe winter storms.

3.3.7.6 Land Use and Development Trends

As the population of Charles County continues to grow, new development can increase vulnerability by increasing the number of assets exposed to the potential impacts of winter storms event. As discussed, all buildings are vulnerable to widespread utility disruptions, including loss of heat and electricity, as well as structure collapse or damage from downed trees.

3.3.8 Temperature Extremes

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Natural	4	2	4	1	3	**3.0**
HIGH RISK (3.0 or higher)						

3.3.8.1 Location, Extent, and Range of Magnitude

Temperature extremes can occur at almost any time of the year, but are most prevalent in the summer and winter. Extreme temperatures can be dangerous due to their effects on individuals who are exposed to them. Extreme heat is usually defined through a combination of temperature and humidity. Extreme heat can also be described as temperatures that hover 10°F or more above the average high temperature for a region during the summer months. Extreme cold is based on the temperature with wind chill. Extreme cold temperatures drop well below what is considered normal for an area during the winter months and may accompany winter storm events. Combined with increases in wind speed, such temperatures in Maryland can be life threatening to those exposed for extended periods of time. The recorded extreme heat events have occurred from June through September. Recorded extreme cold events in Maryland have occurred from December through April. Extreme temperatures can be dangerous to both people and crops.

Charles County is subject to extreme temperatures in the summer and winter seasons. Areas most susceptible to extreme heat include more urban environments tend to retain the heat well into the night, leaving little opportunity for dwellings to cool. Demographics also are a consideration, as large populations of elderly, children, or poor residents represent those most vulnerable to temperature extremes.

Figure 3.3.8-1 and Figure 3.3.8-2 show annual mean maximum and minimum temperatures throughout Maryland and highlight Charles County. These maps present the year-round average minimum temperature (46-50°F) and average maximum temperature (66-68°F). Elevation and topography account for local differences seen on the maps. However, during the summer, the average high temperature is 73.5°F and the average low is 63.0° F in Charles County. In winter, the average high in Charles County is 36.0°F and the average low is 26.0°F (NOAA-NCEI, 2015).

Figure 3.3.8-1: Average Minimum Temperatures for Charles County from 1981 - 2010

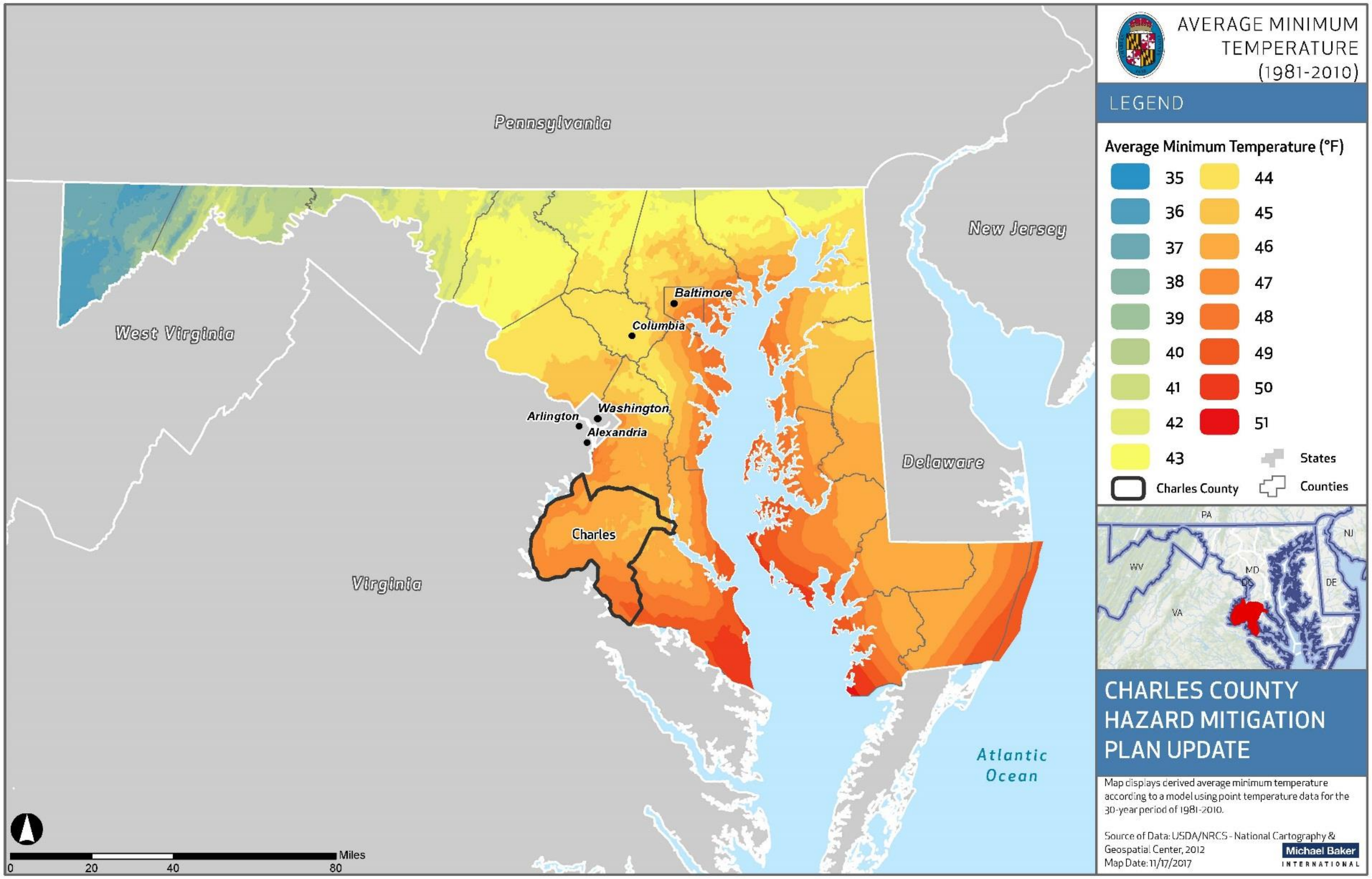
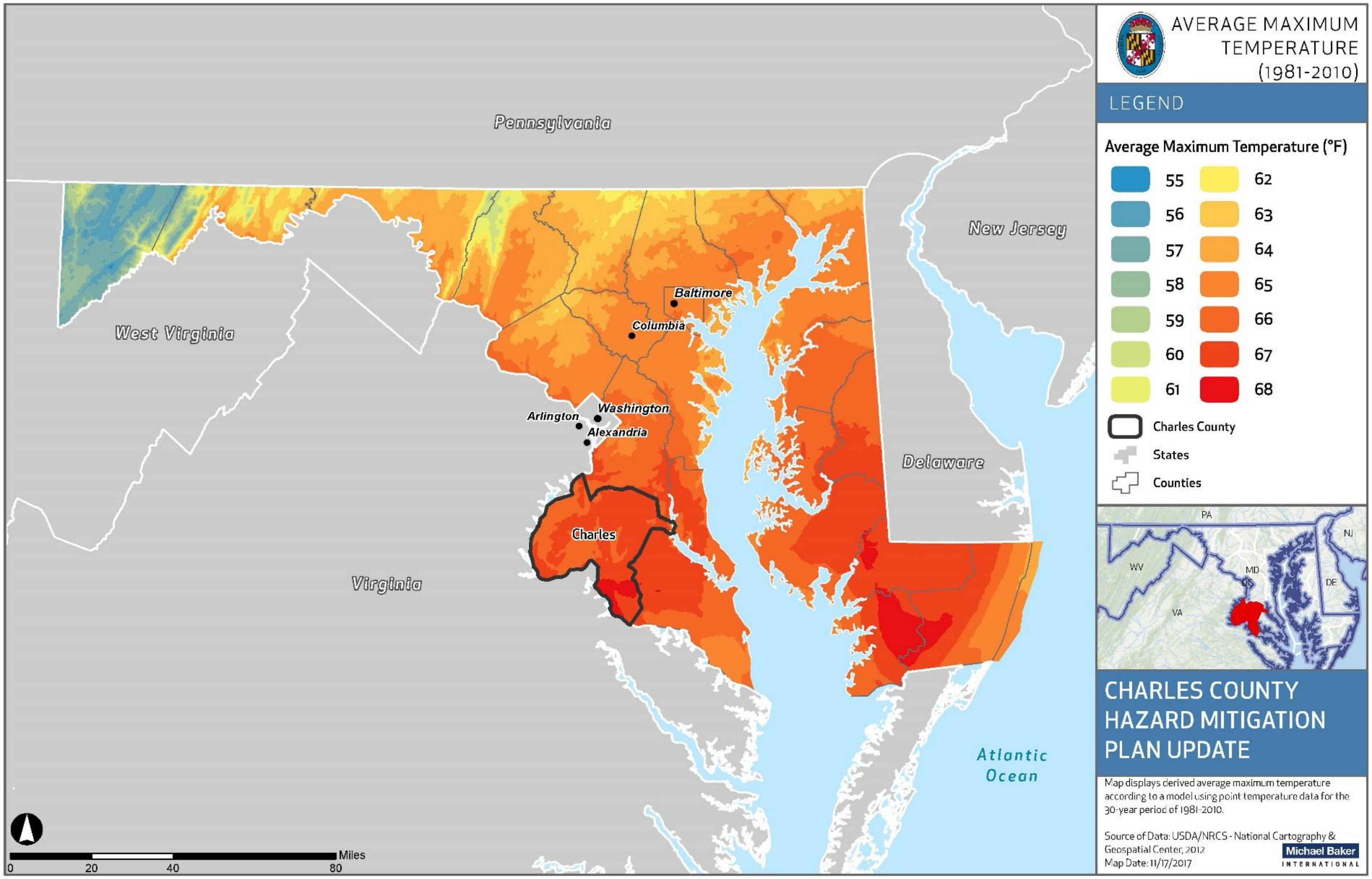


Figure 3.3.8-2: Average Maximum Temperatures for Charles County from 1981 - 2010



The following impacts can be observed following an extreme temperature events:

- ***Health Impacts:*** The health impacts of extreme cold are greater in terms of mortality in humans, but often after more prolonged exposure rather than a cold snap. Extreme heat waves, however, can prove deadlier over a shorter duration. At greatest risk of death in heat waves are the urban-dwelling elderly without access to an air-conditioned environment for at least part of the day.
- ***Transportation:*** Cold weather can impact automotive engines, possibly stranding motorists, and stress metal bridge structures. Highway and railroad tracks can become distorted in high heat. Disruptions to the transportation network and accidents due to extreme temperatures represent an additional risk.
- ***Agriculture:*** Absolute temperature and duration of extreme cold can have devastating effects on trees and winter crops. Livestock is especially vulnerable to heat and crop yields can be impacted by heat waves that occur during key development stages.
- ***Energy***: Energy consumption rise significantly during extreme cold weather, and any fuel shortages or utility failures that prevent the heating of a dwelling can place residents in extreme danger. Extreme heat can also cause utility interruptions, as sagging transmission lines can short out.

Extreme Heat is the number one weather-related killer in the United States. It causes more fatalities each year than floods, lightning, tornadoes, and hurricanes combined. Heat disorders generally related to a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When the body heats too quickly to cool itself safely, or when too much fluid is lost through dehydration or sweating, the body temperature rises, and heat-related illnesses may develop.

Extreme temperatures can result in elevated utility costs to consumers and can cause human risks. Extremely high temperatures cause heat stress which can be divided into four categories (see Table 3.3.8-1). Each category is defined by apparent temperature which is associated with a heat index value that captures the combined effects of dry air temperature and relative humidity on humans and animals. Major human risks for these temperatures include heat cramps, heat syncope, heat exhaustion, heatstroke, and death. Note that while the temperatures in the table serve as a guide for various danger categories, the impacts of high temperatures will vary from person to person based on individual age, health, and other factors.

Table 3.3.8-1: Four Categories of Heat Stress (FEMA, 1997)

DANGER CATEGORY	HEAT DISORDERS	APPARENT TEMPERATURE (°F)
I (Caution)	Fatigue possible with prolonged exposure and physical activity.	80 to 90
II (Extreme Caution)	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and physical activity.	90 to 105
III (Danger)	Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and physical activity.	105 to 130
IV (Extreme Danger)	Heatstroke or sunstroke imminent.	>130

Temperature advisories, watches and warnings are issued by the National Weather Service relating the above impacts to the range of temperatures typically experienced in Maryland. Exact thresholds vary across the State including Charles County, but in general Heat Advisories are issued when the heat index will be equal to or greater than 100°F, but less than 105°F, Excessive Heat Warnings are issued when heat indices will attain or exceed 105°F, and Excessive Heat Watches, are issued when there is a possibility that excessive heat warning criteria may be experienced within twelve to forty-eight hours (NOAA NWS, 2010).

Figure 3.3.8-3: National Weather Service Heat Index

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Extreme Cold is also responsible for many fatalities each year. Threats, such as hypothermia and frostbite, can lead to loss of fingers and toes or cause permanent kidney, pancreas, and liver injury, or even death. Major winter storms can last for several days and are often accompanied by high winds, freezing rain or sleet, heavy snowfall and cold temperatures. Fifty percent of cold-related injuries happen to people over sixty years of age. More than 75% happen to males, and almost 20% occur within the home.

The dangers associated with extreme cold include frostbite and hypothermia. Frostbite is damage to body tissue caused by that tissue being frozen. Frostbite causes a loss of feeling in extremities, such as fingers, toes, ear lobes, or the tip of the nose. Hypothermia, or low body temperature can lead to uncontrollable shivering, memory loss, disorientation, slurred speech, drowsiness, and apparent exhaustion. Table 3.3.8-3 shows the NOAA's National Weather Service cold threat levels and their descriptions.

Table 3.3.8-3: Temperature and Associated Threat Level (NOAA, 2012)

EXCESSIVE COLD THREAT LEVEL	THREAT-LEVEL DESCRIPTION
Extreme	**"An Extreme Threat to Life and Property from Excessive Cold."** A very hard freeze with temperatures below 24 degrees (F)...OR...areas to widespread measurable freezing/frozen precipitation (not a trace) with coverage more than 25% within a defined area...OR...lowest wind chills below 10 degrees (F) with at least 10 mph wind.
High	**"A High Threat to Life and Property from Excessive Cold."** A hard freeze with temperatures between 24 - 27 degrees (F)...OR...patchy measurable freezing/frozen precipitation (not a trace) with coverage less than 25% within a defined area...OR...lowest wind chills 10 - 14 degrees (F) with at least 10 mph wind.
Moderate	**"A Moderate Threat to Life and Property from Excessive Cold."** A significant freeze with temperatures between 28 - 32 degrees (F)...OR...lowest wind chills 15 - 19 degrees (F) with at least 10 mph wind...OR...widespread frost with coverage more than 55% within a defined area.
Low	**"A Low Threat to Life and Property from Excessive Cold."** Near freezing with temperatures between 33 - 35 degrees (F)...OR...lowest wind chills 20 - 24 degrees (F) with at least 10 mph wind...OR...areas of frost with coverage 25 - 54% within a defined area.
Very Low	**"A Very Low Threat to Life and Property from Excessive Cold."** Lowest wind chills 25 - 34 degrees (F) with at least 10 mph wind...OR...patchy frost with coverage less than 25% within a defined area.
Non-Threatening	**"No Discernable Threat to Life and Property from Excessive Cold."** Cold season weather conditions are non-threatening.

3.3.8.2 Past Occurrence

According to NOAA, Charles County has been exposed to 58 occurrences of temperature extremes. Of the 11 events, 7 were extreme cold and the other 51 were excessive heat. These events are shown in Table 3.3.8-4.

The most significant extreme heat event occurred on July 14, 1995. A 38-hour period of extremely hot and humid weather in mid-July took its toll on humans and animals alike. The heat was caused by strengthening of the Bermuda high, extending from the surface to the upper levels of the atmosphere. The most life-threatening period of the heat wave occurred during the afternoon of July 15, when temperatures ranged from 98 to 103, but heat indices were between 115 and 129. For the entire period, heat indices were at or above 90 at most locations. On the evening of the 15th, indices exceeded 100 until around 2am, when outflow from a strong thunderstorm cooled and dried the surface, dropping temperatures and heat indices to the low to mid 70s. In the Baltimore area, there were a reported six deaths from the excessive heat. The Medical Examiner's office reported two other deaths in the state during the same period.

The most significant extreme cold event occurred in March 1998. A series of cold fronts ushered in only the second arctic air mass of the Winter of 1997-1998. The unseasonably frigid air, arriving on the heels of a mild and wet February, may have caused some damage to peach crops in Maryland orchards, especially on the coastal plain. The combination of mild and moist conditions earlier in the winter not only led to accelerated bud growth, but may have decreased the resistance of fruit trees to the hard freeze. In addition to the possible peach damage, early blooming plums and some apricots sustained moderate to heavy damage. The coldest morning, March 13, produced temperatures as low as the low to mid-teens across the northern tier of the state. Minimum temperatures on Marth 11 and 12 averaged in the upper teens to lower 20s; daytime maxima held in the 30s on the 11th and 12th, with some areas (mainly higher terrain over far northern and western sections) failing to rise above freezing for the first time since January 1.

Table 3.3.8-4: Previous temperature extremes impacting Charles County from 1950-2017 (NOAA, 2017).

DATE	EVENT	TEMPERATURE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
5/18/1996	Heat	Mid to upper 90s° F	0	0	$0	$0
7/13/1997	Heat	Upper 90s° F	0	0	$0	$0
8/16/1997	Heat	Low 100s° F (heat index of 105 – 110)	0	0	$0	$0
1/6/1998	Heat	Upper 50s° F	0	0	$0	$0
3/11/1998	Cold/Wind Chill	Low to mid 10s° F (with wind chill)	0	0	$0	$2,500
3/27/1998	Heat	Mid to upper 80s° F	0	0	$0	$0
7/20/1998	Heat	Mid to upper 90s° F (heat index of 100 – 105)	0	0	$0	$0
6/7/1999	Heat	Upper 90s° F to lower 100s° F (heat index 100 – 110)	0	0	$0	$0
7/4/1999	Heat	Upper 90s° F to lower 100s° F (heat index 100 – 115)	0	0	$0	$0
1/2/2000	Excessive Heat	Mid 60s to lower 70s° F	0	0	$0	$0
1/21/2000	Extreme Cold/Wind Chill	-25° F (with wind chill)	0	0	$0	$0
1/22/2000	Extreme Cold/Wind Chill	0° F (with wind chill)	0	0	$0	$0
1/27/2000	Extreme Cold/Wind Chill	0° F (with wind chill)	0	0	$0	$0
3/8/2000	Heat	Low to mid 80s° F	0	0	$0	$0
5/6/2000	Heat	Upper 80s° F to mid 90s° F (heat index of 89 – 97)	0	0	$0	$0
6/10/2000	Heat	Upper 80s° F to mid 90s° F (heat index 95 – 105)	0	0	$0	$0
6/25/2000	Heat	Upper 80s° F to mid 90s° F (heat index 95 – 105)	0	0	$0	$0
12/22/2000	Extreme Cold/Wind Chill	-20° F (with wind chill)	0	0	$0	$0
4/19/2001	Extreme Cold/Wind Chill	20° F (with wind chill)	0	0	$0	$0
6/12/2001	Heat	Low 90s° F (heat index 100)	0	0	$0	$0
6/27/2001	Heat	Low 90s° F (heat index 100)	0	0	$0	$0

Table 3.3.8-4: Previous temperature extremes impacting Charles County from 1950-2017 (NOAA, 2017).

DATE	EVENT	TEMPERATURE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
8/6/2001	Heat	High 90s° F (heat index 98 – 112)	0	0	$0	$0
7/2/2002	Heat	Mid 90s° F (heat index 100 – 110)	0	0	$0	$0
7/22/2002	Heat	Mid 90s° F (heat index 98 – 105)	0	0	$0	$0
7/28/2002	Heat	Mid 90s° F (heat index 100 – 110)	0	0	$0	$0
8/1/2002	Heat	High 90s° F (heat index 98 – 110)	0	0	$0	$0
8/12/2002	Heat	High 90s° F (heat index 95 – 100)	0	0	$0	$0
8/22/2002	Heat	Mid 90s° F (heat index 95 – 105)	0	0	$0	$0
12/7/2002	Cold/Wind Chill	6° F (with wind chill)	0	0	$0	$0
7/17/2006	Heat	(heat index 100 – 105)	0	0	$0	$0
7/18/2006	Heat	(heat index 100 – 105)	0	0	$0	$0
8/1/2006	Heat	(heat index 105 – 115)	0	0	$0	$0
6/1/2011	Heat	(heat index > 100)	0	0	$0	$0
6/9/2011	Heat	(heat index > 100)	0	0	$0	$0
7/21/2011	Excessive Heat	(heat index 115)	0	0	$0	$0
7/22/2011	Excessive Heat	Low 100s° F (heat index > 115)	0	0	$0	$0
7/29/2011	Heat	(heat index > 105)	0	0	$0	$0
5/28/2012	Heat	(heat index > 100)	0	0	$0	$0
6/20/2012	Heat	(heat index > 100)	0	0	$0	$0
6/21/2012	Heat	(heat index > 100)	0	0	$0	$0
6/29/2012	Excessive Heat	(heat index > 110)	0	0	$0	$0
7/5/2012	Heat	(heat index > 100)	0	0	$0	$0
7/7/2012	Excessive Heat	(heat index > 110)	0	0	$0	$0
7/8/2012	Excessive Heat	(heat index > 110)	0	0	$0	$0
7/18/2012	Heat	(heat index > 100)	0	0	$0	$0
7/26/2012	Heat	(heat index > 100)	0	0	$0	$0
7/18/2013	Heat	(heat index > 105)	0	0	$0	$0
7/19/2013	Heat	(heat index > 105)	0	0	$0	$0

Table 3.3.8-4: Previous temperature extremes impacting Charles County from 1950-2017 (NOAA, 2017).

DATE	EVENT	TEMPERATURE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
7/23/2016	Heat	(heat index > 100)	0	0	$0	$0
7/25/2016	Heat	(heat index > 100)	0	0	$0	$0
8/12/2016	Heat	(heat index > 100)	0	0	$0	$0
8/13/2016	Heat	(heat index > 100)	0	0	$0	$0
8/16/2016	Heat	(heat index > 100)	0	0	$0	$0
7/13/2017	Heat	(heat index > 100)	0	0	$0	$0
7/14/2017	Heat	(heat index > 100)	0	0	$0	$0
7/20/2017	Heat	(heat index > 100)	0	0	$0	$0
7/21/2017	Heat	(heat index > 100)	0	0	$0	$0
8/18/2017	Heat	(heat index > 100)	0	0	$0	$0
Total			**0**	**0**	**$0**	**$2,500**

3.3.8.3 Future Occurrence

Based on historical occurrences of extreme temperature events, the probability that Charles County will face an extreme temperature event in the future is *highly likely* (4 out of 4) as defined by the Risk Factor Methodology probability criteria. Based on location and geography, it is more likely that extreme heat events will impact the County than extreme cold events.

3.3.8.4 Vulnerability Assessment

The potential for extreme heat and cold always exists in and around the summer and winter months. Meteorologists and weather forecasters can normally predict the temperature with excellent accuracy. Adhering to extreme temperature warnings can significantly reduce the risk of temperature related deaths. Extreme heat and cold primarily impact people rather than buildings or critical facilities. Those hardest hit by both heat and cold waves are adults 65 years of age or older, many who are already physically vulnerable. Excessive heat exposure also affects people with certain pre-existing medical conditions, including cardiovascular disease, respiratory illnesses, and obesity. Small children are also more susceptible to temperature extremes.

Additionally, buildings or infrastructure of significant age may be more susceptible to temperature extremes. For example, burst pipes could damage buildings and necessitate repairs during extreme cold events, and HVAC or air-conditions systems could overheat or be damaged during an extreme heat event. Additionally, power outages during extreme heat or cold events could have significant consequences to people that occupy buildings. However, the primary impacts of extreme temperatures are on people rather than buildings. Nonetheless, facilities need to be maintained to ensure that they operate in appropriate conditions for people.

3.3.8.5 Jurisdictional Differences

The entirety of Charles County and its jurisdictions are considered vulnerable to the effects of extreme temperatures, but as discussed, these vulnerabilities are extremely individualized among the general population and are will continue to be extremely difficult to address from a county-wide or even local emergency response level. As of 2016, 52.3% of the population of Port Tobacco was age 65 or older, while 14.7% of La Plata's population and 8.5% of Indian Head's population were in this age group. Countywide, 11% of the population was age 65 or older in 2016 (U.S. Census, 2016). Based on this data, the populations of Port Tobacco and La Plata are more vulnerable to the impacts of extreme heat and cold than the population of the County as a whole, while residents of Indian Heat are slightly less vulnerable.

Additionally, as shown in Figures 3.3.8-1 and 3.3.8-2, the northern part of the County annually experiences cooler temperatures on average, while the southern part of the County is typically warmer. This makes the northern part of Charles County slightly more vulnerable to the impacts of extreme cold and less vulnerable to the impacts of extreme heat than areas in the southern part of the County, while communities in the southern portion of the County are slightly more vulnerable to extreme heat and less vulnerable to extreme cold events.

3.3.8.6 Land Use and Development Trends

All future structures and infrastructure built in Charles County will likely be exposed to extreme temperature events; however, people are more vulnerable to these events than structures or infrastructure. As a result, the location of development will not increase or reduce risk to this hazard, but changing demographics and population characteristics as a result of new development have the potential to impact the County’s vulnerability to extreme temperatures.

3.3.9 Wildfire

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Natural	1	1	1	4	2	**1.4**
LOW RISK (Less than 2.0)						

3.3.9.1 Location, Extent, and Range of Magnitude

Wildfires can occur during anytime of the year; however, wildfires are likely to ensue during the spring and fall. This is due to the increase of fallen leaves from deciduous trees, along with the combination of sunlight and wind, which promotes drying. The relative humidity combined with a breeze creates the conditions for wildfires to spread rapidly. Fires can be rated based on their ability to ignite. The five fuel types, which makeup Maryland's land cover are listed below (Maryland Department of Natural Resources, 2017):

- **Deciduous Hardwood Forest:** Deciduous forests makeup a large percentage of Charles County's vegetation. Depending on the amount hardwood debris accumulated from dried leaves and plants, can determine fire intensity and rate of spread. Fires fueled by hardwood litter will typically burn the surface leaves and debris, with flames ranging from 1-4 feet. In areas of dense dried shrubs, fire intensity is likely to increase substantially and smolder for long periods of time.
- **Tall Grass:** Tall grass makes up a small percentage of Charles's County's land cover, and typically grows in fields or plains. When cured and dried in abundance, tall grass burns hot and fast. Under the influence of a strong wind, and flames ranging 12-18 feet, fires can spread at a very fast rate.
- **Evergreen Litter:** Evergreen trees can be found in the lower southwestern portion of the County, near Nanjemoy, Doncaster State Forest, and Smallwood State Park. Evergreens are also grown in abundance in the northeastern and southeastern areas of Charles County, around Mt. Victoria. The buildup of dried pine needles can easily ignite and spread, and flames from evergreen debris can range from 1 to 6 feet.
- **Evergreen Overstory:** In stands of densely packed evergreens and pines, surface fires can spread upwards towards the tree canopy. This could eventually result in crown fires, which spread from treetop to treetop, resulting in the torching of trees.
- **Marsh:** Although marshes are surrounded by water, they have a large quantity of fine fuels, which can burn rapidly. Flame lengths of marsh fires can reach 20 feet or more. Marshes are present along low-lying wetlands in Charles County, including parts of Mattawoman Creek and Nanjemoy Creek.

The leading cause of wildfires in Maryland is due to human activity, improper debris, or outdoor burning that ignites an average of 28% of the fires each year. The second leading cause of wildfires in Maryland is arson, which accounts for 23% of ignitions. Other sources of wildfire ignitions include smoking, campfires, poorly discarded ashes, railroads, equipment use, downed power lines, and fireworks. Lightning is however, the only natural cause of all wildfires, and accounts for 4% of wildfire ignitions in Maryland (Maryland Department of Natural Resources, 2017).

Most wildfires in Maryland are surface fires, which burn fallen debris along the “duff” layer. The duff layer is comprised of decomposed leaves, needles, twigs, and other organic material. During dry periods, fires can burn underground in this duff layer, for weeks, or even months, and cause severe issues (Maryland Department of Natural Resources, 2017). Fire intensity is typically higher in areas of dense vegetative fuels, such as grasses, evergreens, and shrubs. Maryland rarely experiences wildfires that burn in the tree canopy, known as crown fires. However, crown fires can still occur during very dry and windy seasons, along dense stands of evergreen trees. Fuels, weather, and topography are the three factors that control wildfire behavior.

Wildfires are dependent upon the quantity and quality of available fuels. Fuel quantity is the mass per unit area. Fuel quality is determined by several factors, including fuel density, chemistry, and arrangement. Arrangement influences the availability of oxygen. Another important aspect of fuel quality is the total surface exposed to heat and air. Fuels with large area-to-volume ratios, such as grasses, leaves, bark and twigs, are easily ignited when dry.

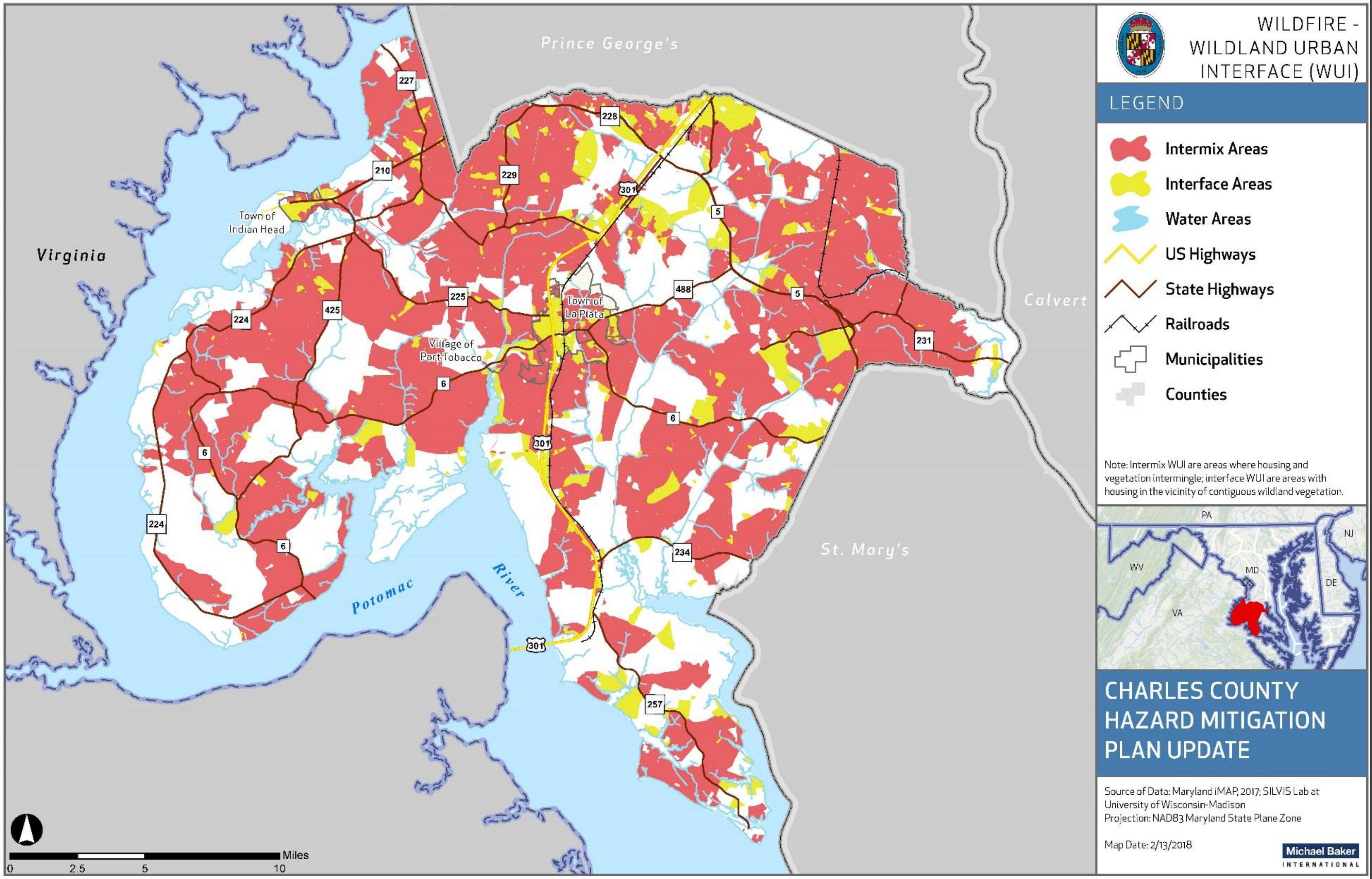
Climatic and meteorological conditions that influence wildfires include solar insulation, atmospheric humidity, and precipitation, all of which determine the moisture content of wood and leaf litter. Dry spells, heat, low humidity, and wind increase the susceptibility of vegetation to fire. Various natural and human agents can be responsible for igniting wildfires. Natural agents include lightning, sparks generated by rocks rolling down a slope, friction produced by branches rubbing together in the wind, and spontaneous combustion.

Wildfire events can range from small fires that can be managed by local firefighters to large fires impacting many acres of land. Large events may require evacuation from one or more communities and necessitate regional or national firefighting support. The impact of a severe wildfire can be devastating. While some fires are not human-caused and are part of natural succession processes, a wildfire can kill people, livestock, fish, and wildlife. They often destroy property, valuable timber, forage, and recreational and scenic values.

Vegetation loss is often an environmental concern with wildfires, but it typically is not a serious impact since natural re-growth occurs with time. The most significant environmental impact of vegetation loss is the potential for severe erosion, silting of stream beds and reservoirs, and flooding due to ground-cover loss following a fire event. Wildfires can also have a positive environmental impact in that they burn dead trees, leaves, and grasses to allow more open space for new and different types of vegetation to grow and receive sunlight. Another positive effect of a wildfire is that it stimulates the growth of new shoots on trees and shrubs, and a fire’s heat can open pine cones and other seed pods.

Areas at the greatest risk to wildfire events are those where structures and other human development meet undeveloped wildland. This area is referred to as the Wildland-Urban Interface (WUI), which is characterized by an environment where fire can readily move between structural and vegetation fuels. Figure 3.3.9-1 depicts WUI areas and intermix areas. Intermix areas are defined as those where housing and vegetation intermingle, whereas WUI areas are characterized by development in the vicinity continuous wildland vegetation. Much of Charles County is located in both intermix and interface areas.

Figure 3.3.9-1: Wildland Urban Interface and Intermix Areas in Charles County



3.3.9.2 Past Occurrence

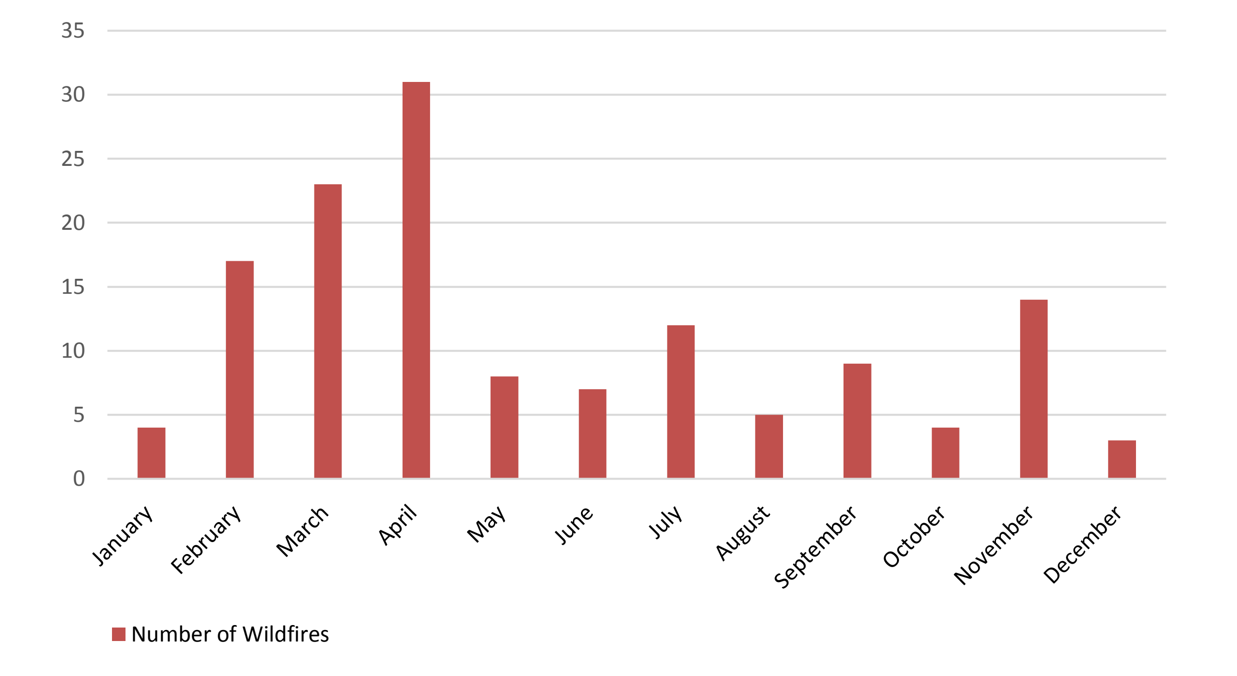
On average, the Maryland Forest Service (MFS) responds to 325 wildfires a year (Maryland Department of Natural Resources, 2017). These same fires are capable of burning more than 3,200 acres of forest, brush, and grasses. Although, some wildfires in Maryland can burn hundreds or even thousands of acres, a majority of them burn less than 10 acres. At the same time, these smaller wildfires still threaten nearby developments, wildlife, natural resources, and lives. Each year wildfires threaten hundreds of homes or structures, while dozens are either damaged or destroyed.

Table 3.3.9-1: Regional Wildfire Statistics for Southern Maryland 2011-2015 (DNR, 2015).

YEAR	NUMBER OF FIRES	ACRES BURNED
2011	18	1,303.9
2012	45	49.5
2013	34	51.3
2014	19	10.3
2015	36	20.9
Total	**152**	**1,435.9**

In 2015, 23 percent of wildfires in Maryland took place in the southern region, which includes Charles County. This amounted to 36 wildfire events. During the five-year period highlighted in Table 3.3.9-1, 152 fires occurred in Southern Maryland, which burned over 1,400 acres. The majority of this burning occurred in 2011 (DNR, 2015).

Figure 3.3.9-2: Average Number of Statewide Wildfires by Month 2011-2015 (DNR, 2015)



As shown in Figure 3.3.9-2, wildfire events have occurred most frequently throughout Maryland over the past five years in the months of April, March, February, and November. The greatest potential for wildfire events typically occurs in the spring and fall months. In the spring, bare trees allow sunlight to reach the forest floor, drying fallen leaves and other ground debris. Additionally, increasing daytime temperature, low relative humidity, and wind promotes the ignition and spread of fires. The springtime is also when the largest fires will occur. The fall months are typically a time of depleted soil moisture, low stream conditions, and reduced leaf canopies, which accounts for the increase in fires for the month of November. Wildfires that generally occur in the summer are most often associated with droughts. 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.

3.3.9.3 Future Occurrence

Previous events in Southern Maryland and the presence of WUI areas in Charles County suggest that wildfire has the potential to occur in the County. Weather conditions like drought can increase the likelihood of wildfires occurring. Many wildfires could also be caused by the result of human-caused ignitions. However, due to relatively few past wildfire occurrences and impacts in Charles County, the probability of a wildfire occurring in Charles County is considered *unlikely* (1 of 4) as defined by the Risk Factor Methodology probability criteria.

3.3.9.4 Vulnerability Assessment

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 include 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.

In the past wildfires and brush fires in Maryland have forced school closings, disrupted telephone services by burning fiber optic cables, damaged railroads and other infrastructure, and adversely affected tourism, outdoor recreation, and hunting. The likelihood of one of those fires attaining significant size and intensity is unpredictable and highly dependent on environmental conditions and firefighting response. Weather conditions, particularly drought events, increase the likelihood of wildfires occurring. Yet, it is equally important to note that 96 percent of wildfires are human-caused, making their occurrence harder to foresee.

Table 3.3.9-2 depicts the number of structures, critical facilities, and populations that intersect the WUI areas depicted in Figure 3.3.9-1. This analysis only focused on WUI areas and not intermix areas due to the higher risk associated with WUI areas. As shown in the table, nearly 30% of structures in the County are located in WUI areas, including more than half of all structures in Indian Head and La Plata. Additionally, 25% of all critical facilities in Charles County, and 34% of the population are located in these areas. Critical facilities that intersect the WUI are shown in by type in Table 3.3.9-3, while specific critical facilities related to emergency response operations and government and school operations are shown in Table 3.3.9-4. There were also a number of historic and cultural resources located in WUI areas, which are discussed in Section 4.3.4.

Table 3.3.9-2: Structures, Critical Facilities, and Populations Vulnerable to Wildfires (WUI areas)

MUNICIPALITY	TOTAL STRUCTURES	TOTAL STRUCTURES IN WUI AREA	PERCENT STRUCTURES IN A WUI AREA	TOTAL CRTICAL FACILITIES	CRITICAL FACILITIES IN WUI AREA	PERCENT CRITICAL FACILITIES IN WUI AREA	TOTAL ESTIMATED 2010 POPULATION	POPULATION IN WUI AREA	PERCENT POPULATION IN WUI AREA
Charles County Unincorporated Areas	61,656	17,061	27.67%	573	132	23.04%	134,384	41,901	31.18%
Town of Indian Head	1,680	1,252	74.52%	23	18	78.26%	3,833	2,758	71.95%
Town of La Plata	4,126	2,636	63.89%	82	23	28.05%	8,321	5,744	69.03%
Village of Port Tobacco	11*	4	36.36%	0	0	0.00%	13	5	38.46%
Total	**67,473**	**20,953**	**31.05%**	**678**	**173**	**25.52%**	**146,551**	**50,408**	**34.40%**

** The Village of Port Tobacco noted that there are 22 structures in the jurisdiction; however, this analysis was conducted with GIS data which only included 11.*

Table 3.3.9-3: Critical Facilities Vulnerable to Wildfires (WUI areas) By Type

MUNICIPALITY	AIRPORTS	AMBULANCE/EMS STATIONS	CHURCHES	COMMUNICATION FACILITIES	DAY CARE CENTERS	ELECTRIC SUBSTATION	FIRE STATIONS	GOVERNMENT BUILDINGS	NURSING HOMES AND LONG-TERM CARE FACILITIES	POLICE STATIONS	PUMP STATIONS	SCHOOLS	WELLS	GRAND TOTAL
Charles County Unincorporated Areas	1	5	33	12	6	6	6	0	27	1	11	3	21	132
Town of Indian Head	0	1	10	2	1	0	1	1	0	0	1	0	1	18
Town of La Plata	0	1	2	0	2	1	1	2	5	0	5	2	2	23
Village of Port Tobacco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**1**	**7**	**45**	**14**	**9**	**7**	**8**	**3**	**32**	**1**	**17**	**5**	**24**	**173**

Table 3.3.9-4: Emergency Response, Government, and School Facilities Vulnerable to Wildfire

NAME	TYPE	COMMUNITY
Benedict Vol Fire Dept. Inc	Ambulance/EMS Stations	Charles County Unincorporated Areas
Bryans Rd Vol Fire Dept.	Ambulance/EMS Stations	Charles County Unincorporated Areas
Charles County Rescue Squad, Inc	Ambulance/EMS Stations	Town of La Plata
Hughesville Vol F D & RS Inc	Ambulance/EMS Stations	Charles County Unincorporated Areas
Indian Head Vol Fire Dept.	Ambulance/EMS Stations	Town of Indian Head
Potomac Heights. Vol Fire Dept.	Ambulance/EMS Stations	Charles County Unincorporated Areas
Waldorf Vol Fire Dept. Inc	Ambulance/EMS Stations	Charles County Unincorporated Areas
Benedict Vol Fire Dept. Inc	Fire Stations	Charles County Unincorporated Areas
Bryans Rd Vol Fire Dept.	Fire Stations	Charles County Unincorporated Areas
Hughesville Vol F D & RS Inc	Fire Stations	Charles County Unincorporated Areas
Indian Head Vol Fire Dept.	Fire Stations	Town of Indian Head
La Plata Volunteer Fire Dept. Inc	Fire Stations	Town of La Plata
Nanjemoy Volunteer Fire Dept. Inc	Fire Stations	Charles County Unincorporated Areas
Potomac Heights. Vol Fire Dept.	Fire Stations	Charles County Unincorporated Areas
Waldorf Vol Fire Dept. Inc	Fire Stations	Charles County Unincorporated Areas
Board Town Comm. of Indian Head	Government Buildings	Town of Indian Head
Charles County Commissioners	Government Buildings	Town of La Plata
La Plata Town Hall	Government Buildings	Town of La Plata
Sheriff'S Office - District II	Police Stations	Charles County Unincorporated Areas
Archbishop Neale School	Schools	Town of La Plata
Arthur Middleton Elementary	Schools	Charles County Unincorporated Areas
Dr. Gustavus Brown School	Schools	Charles County Unincorporated Areas
Jennifer Elementary	Schools	Charles County Unincorporated Areas
Milton Somers Middle School	Schools	Town of La Plata

3.3.9.5 Jurisdictional Differences

As highlighted in Table 3.3.9-2, the Town of Indian Head is at the highest risk to wildfire events, followed by La Plata. Both of these communities are at a higher risk than the unincorporated areas of Charles County and the Village of Port Tobacco; however, WUI areas and intermix areas existing throughout much of the County.

3.3.9.6 Land Use and Development Trends

As human development continues to increase in Charles County, so will the number of WUIs and intermix areas. The potential for property damage and other wildfire impacts will increase each year as more properties are developed and more people move to these areas. However, encouraging principles of defensible space in new and existing development in these areas could help reduce the potential for wildfires to spread to structures.

HUMAN-MADE HAZARDS

3.3.10 Building and Structure Collapse

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Human-Made	2	2	1	3	3	**2.0**
LOW RISK (Less than 2.0)						

3.3.10.1 Location, Extent, and Range of Magnitude

Buildings and other engineered structures, including bridges, may collapse if their structural integrity is compromised, especially due to effects from other natural or human-made hazards. Older buildings or structures, structures that are not built to standard codes, or structures that have been weakened are more susceptible to be affected by these hazards.

Adherence to modern building codes can lower a building's risk to collapse. Building codes – developed by the International Code Council in partnership with FEMA and other federal, state, local, and private authorities – specify the minimum legal design and construction requirements for structural integrity, construction materials, and fire protection (FEMA, 2014). Most buildings constructed after 1981 in Charles County were built under modern building codes as adopted in the Energy Conservation Building Standards Act, which established the Maryland Building Performance Standards. Throughout the County, approximately 65.2% of structures were built after 1980, which indicates that a significant portion were constructed prior to when these standards were in place (U.S. Census, 2016).

Bridges serve to connect both large and small roadways and communities throughout the County. Whether they span another roadway or a body of water, bridges are a crucial part of every transportation system. However, many of Maryland's bridge structures are aging and in need of repair. Inspection and maintenance are necessary to observe and mitigate the extent of disrepair, especially on older structures.

There are different effects of a collapse, depending on the type and cause of the collapse and the type of structure that collapses. A building collapsing in on itself will likely result in debris field which is dense but has a small footprint. However, if a building collapses in an outward direction, the debris field will be more widely scattered (University of Michigan, 2011). Both of these types of collapses can cause injury to and endanger the lives of those inside or near to the structure and can result in damages to nearby property, especially if the collapse causes a large amount of debris near a populated area. Though occupied buildings are less likely to collapse since they would generally be maintained, more risk of death or injury would be likely with the sudden collapse of an occupied building.

Disrepair can critically affect the integrity of the bridge structure. The level of disrepair depends on how much of the structure is damaged and how critical that portion of the structure is to the safety of drivers. Some structures only need deck replacement or a new superstructure, while others have substructure problems and should be entirely replaced. As of April 1, 2017, 67 of the state's 2,567 bridges were classified as structurally deficient. Five of these are located in Charles County, although none are currently closed to traffic (MDOT, 2017a). A list of these bridges is shown in Table 3.3.10-1.

Table 3.3.10-1: Structurally Deficient Bridges in Charles County (MDOT, 2017a)					
BRIDGE NUMBER	ROUTE	FEATURE CROSSED	YEAR BUILT	AVERAGE DAILY TRAFFIC	STRUCTURALLY DEFICIENT FEATURE
080007001	MD 6	Zekiah Swamp	1933	12,432	Deck Deterioration
080020001	MD 224	Thorne Gut	1947	112	Deck Deterioration
080021001	MD 225	Mattawoman Creek	1951	8,750	Culvert Deterioration
080038001	MD 254	Neale Sound	1963	2,290	Deck Deterioration
080047001	MD 234	Gilbert Swamp Run	1959	5,930	Concrete Deterioration

While not listed as a structurally deficient bridge as of 2017, the 75-year old Governor Harry W. Nice Memorial Bridge is also a potential risk for Charles County. This 1.7-mile bridge spans the Potomac River to connect the community of Newburg in Charles County with Dahlgren, Virginia. It was determined that the current bridge would require a major rehabilitation project within the next five years, and as a result, it was announced in 2016 that the bridge will be replaced. Construction of the new bridge is planned to commence in 2020, and a wider, safer bridge is scheduled to open in 2023. The existing bridge will be demolished upon completion of the project (MDTA, 2016).

A worst-case scenario for a bridge structure collapse is for a high traffic bridge to collapse during rush hour causing many injuries and several deaths. A worst case scenario for a building collapse would be for a building with multiple people in it to collapse in a denser area causing injuries and possible death to those in the building as well as around the area.

3.3.10.2 Past Occurrence

A notable collapse occurred in 2010 in Waldorf as the result of a fire. One commercial building and all of its contents were lost and damage was estimated at $650,000 (The Bay Net, 2010). There have been no reported occurrences of bridge collapses in Charles County.

3.3.10.3 Future Occurrence

Structures and buildings can collapse due to deterioration of bridge critical load bearing members and building structural integrity, but external occurrences can also impact bridges and buildings. There have not been many notable issues with building structural integrity in Charles County, but without proper maintenance and code enforcement this risk can grow. The County has a significant number of older structures, and approximately 3,909 vacant housing units, there is an increased risk of building collapse. Additionally, other hazard events such as fires, winter storms, and tropical storms could create conditions that would cause buildings or structures to collapse. The future occurrence of building and structure collapse can be considered *possible* (2 out of 4) as defined by the Risk Factor methodology probability criteria.

3.3.10.4 Vulnerability Assessment

The most vulnerable areas of the County are those with the highest concentration of deteriorating structures. Structures can either collapse into themselves or in an outward direction depending on the cause of the collapse. Construction activities, earthquakes, and subsidence can lead to a structure collapsing in on itself. Weather related hazards, including snowfall and wind, and terrorism can cause a building to collapse in an outward direction (University of Michigan, 2011). Since the HMPC determined that Charles County is not at great risk to earth disturbance hazards, the greatest risk for collapse is from cascading effects on structures, especially those with lower pre-existing structural integrity, by construction activities, from heavy snowfall during winter storms, from an imbalance of water forces on either side of a structural wall, and from high winds during storms.

As discussed, five bridges throughout Charles County are structurally deficient. Structurally deficient bridges are often still safe for vehicles to cross over, but will need work in the near future. All of these bridges are located in unincorporated areas of the County.

3.3.10.5 Jurisdictional Differences

Unincorporated areas of Charles County and Port Tobacco Village face the greatest risks to structure collapse, as all structurally deficient bridges are located in these areas. The age of the building stock in an area also influences vulnerability to structure collapse, and areas with a large portion of structures built prior to 1980 may be at higher risk. These include the Town of Port Tobacco Village (100% of structures built prior to 1980) and the communities of Nanjemoy (56.9%), Thompkinville (56.3%), Pomonkey (55.5%), Bryantown (52.7%), and Marbury (50.2%). These communities are all located in the unincorporated areas of Charles County; however, over 30% of structures in the Town of La Plata were built prior to 1980, which indicates that this jurisdiction may be at a higher risk to building and structure collapse as well (U.S. Census, 2016).

3.3.10.6 Land Use and Development Trends

Continuing to adhere to building codes and development regulations and maintaining aging infrastructure will reduce the risk of building and structure collapse in the future; however, older buildings or structures, structures that were not built to standard codes, or structures that have been weakened will remain more susceptible to this hazard. Because the impacts of building or structure collapse are highly localized, new development in areas with older structures or infrastructure is unlikely to increase risk.

3.3.11 Civil Disturbance and Criminal Activity

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Human-Made	3	2	1	3	1	**2.1**
MODERATE RISK (2.0 – 2.9)						

3.3.11.1 Location, Extent, and Range of Magnitude

Civil disturbance is a broad term that is typically used by law enforcement to describe one or more forms of disturbance caused by a group of people. Civil disturbances are typically a symptom of and a form of protest against major socio-political problems. Civil disturbance hazards include the following:

- ***Famine****:* Involves a widespread scarcity of food leading to malnutrition, increased mortality, and a period of psychosocial instability associated with the scarcity of food, such as riots, theft of food, and the fall of governments caused by political instability borne of an inability to deal with the crisis caused by famine.
- ***Economic Collapse or Recession****:* Very slow or negative growth.
- ***Misinformation****:* Erroneous information spread unintentionally.
- ***Civil Disturbance, Public Unrest, Mass Hysteria, and Riot****:* Group acts of violence against property and individuals, for example.
- ***Strike or Labor Dispute****:* Controversies related to the terms and conditions of employment, for example.

Typically, the severity of the action coincides with the level of public outrage. In addition to a form of protest against major socio-political problems, civil disturbances can also arise out of union protest, institutional population uprising, or from large celebrations that become disorderly.

The scale and scope of civil disturbance events varies widely. However, government facilities, landmarks, prisons, and universities are common sites where crowds and mobs may gather. Civil disturbances can take the form of small gatherings or large groups blocking or impeding access to a building, or disrupting normal activities by generating noise and intimidating people. They can range from a peaceful sit-in to a full-scale riot, in which a mob burns or otherwise destroys property and terrorizes individuals. Even in its more passive forms, a group that blocks roadways, sidewalks, or buildings interferes with public order. There are two types of large gatherings typically associated with civil disturbances: a crowd and a mob. A crowd may be defined as a casual, temporary collection of people without a strong, cohesive relationship. Crowds can be classified into four categories:

- ***Casual Crowd:*** A casual crowd is merely a group of people who happen to be in the same place at the same time. Violent conduct does not occur.
- ***Cohesive Crowd:*** A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity, such as worshipping, dancing, or watching a sporting event. Although they may have intense internal discipline, they require substantial provocation to arouse to action.

- ***Expressive Crowd:*** An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are assembled as an expression of common sentiment or frustration. Members wish to be seen as a formidable influence. One of the best examples of this type is a group assembled to protest.
- ***Aggressive Crowd:*** An aggressive crowd is comprised of individuals who have assembled for a specific purpose. This crowd often has leaders who attempt to arouse the members or motivate them to action. Members are noisy and threatening and will taunt authorities. They may be more impulsive and emotional, and require only minimal stimulation to arouse violence. Examples of this type of crowd could include demonstrators and strikers, though not all demonstrators and strikers are aggressive.

A mob can be defined as a large disorderly crowd or throng. Mobs are usually emotional, loud, tumultuous, violent, and lawless. Similar to crowds, mobs have different levels of commitment and can be classified into four categories (Alvarez and Bachman, 2007):

- ***Aggressive Mob:*** An aggressive mob is one that attacks, riots, and terrorizes. The object of violence may be a person, property, or both. An aggressive mob is distinguished from an aggressive crowd only by lawless activity. Examples of aggressive mobs are the inmate mobs in prisons and jails, mobs that act out their frustrations after political defeat, or violent mobs at political protests or rallies.
- ***Escape Mob:*** An escape mob is attempting to flee from something such as a fire, bomb, flood, or other catastrophe. Members of escape mobs are generally difficult to control and can be characterized by unreasonable terror.
- ***Acquisitive Mob:*** An acquisitive mob is one motivated by a desire to acquire something. Riots caused by other factors often turn into looting sprees. This mob exploits a lack of control by authorities in safeguarding property.
- ***Expressive Mob:*** An expressive mob is one that expresses fervor or revelry following some sporting event, religious activity, or celebration. Members experience a release of pent up emotions in highly charged situations.

Seldom have civil disorder events been recorded in Charles County's recent history; however, criminal activity occurs much more frequently and is defined as an act committed in violation of the law. The following are categories of criminal activity used when describing various crimes throughout Charles County and neighboring areas (CrimeReports, 2017):

- **Assault:** An unlawful attack by one person upon another.
- **Assault with a Deadly Weapon:** An unlawful attack by one person upon another for the purpose of inflicting severe or aggravated bodily injury.
- **Arson:** Any willful or malicious burning or attempt to burn, with or without intent to defraud, a dwelling, house, public building, motor vehicle, aircraft, or personal property of another.
- **Homicide:** The willful killing of one human being by another.

- **Kidnapping:** The crime of unlawfully seizing and carrying away a person by force or Fraud, or seizing and detaining a person against his or her will with an intent to carry that person away at a later time.
- **Robbery:** The taking or attempting to take anything of value from the care, custody, or control of a person by force, threat of violence, and/or by putting the victim in fear.
- **Other Sexual Offense:** Offenses that are sexual in nature and not immediately classified as a Sexual Offense or Sexual Assault.
- **Sexual Assault:** The carnal knowledge of an individual forcibly and against her or his will.
- **Sexual Offense:** This classification includes offenses against chastity, common decency, morals, and the like.
- **Breaking and Entering:** The unlawful entry of a structure to commit a felony or a theft.
- **Property Crime:** General crimes committed on residential or commercial property.
- **Theft:** The taking or attempting to take anything of value from the care, custody, or control of a person.
- **Disorder:** Any behavior that tends to disturb the public peace or decorum, scandalize the community, or shock the public sense of morality.
- **Drugs:** The violation of laws prohibiting the production, distribution, and/or use of certain controlled substances and the equipment or devices utilized in their preparation and/or use. The unlawful cultivation, manufacture, distribution, sale, purchase, use, possession, transportation, or importation of any controlled drug or narcotic substance.
- **Liquor:** Driving or operating a motor vehicle or common carrier while mentally or physically impaired as the result of consuming an alcoholic beverage or using a drug or narcotic.
- **Weapons Offense:** The violation of laws or ordinances prohibiting the manufacture, sale, purchase, transportation, possession, concealment, or use of firearms, cutting instruments, explosives, incendiary devices, or other deadly weapons.
- **Traffic Violation:** A violation of traffic law or code.

The worst-case scenario for Charles County would be an aggressive crowd or an expressive mob protesting on or within a major thoroughfare, most likely formed near a major educational institution or headquarters. This scenario would also involve property damage and possible injury. Civil disturbances also pose as major threats to mobility, local economies, educational systems, and are capable of damaging structures, including those which are of historical and archaeological origin.

3.3.11.2 Past Occurrence

Historically the Town of Port Tobacco in Charles County has had several riots, most notably the one which took place shortly after the Revolutionary War in 1786. Another significant historical riot in Charles County occurred in 1765. As a result of the Stamp Act crisis in 1765, the court of Port Tobacco closed its doors as a sign of the refusal to pay the newly instated stamp tax. Later in late 1774, just after the Continental Congress adopted a trade embargo to protest British imperial policies, a group of Charles County residents forced the court to adjourn. Again, in June of 1786 an angry riot began at the Port Tobacco courthouse in response to local merchants refusing to use British goods (Maryland Historical Magazine, 1990).

Despite Port Tobacco's rich history of civil disturbances, there has been few reported cases in Charles County in recent time. However, surrounding areas in Maryland, such as Baltimore, have had several destructive riots in 2015. While these occurrences did not take place in Charles County, they may however have created a sudden fear for Charles County residents and limited their mobility.

The Charles County Sheriff's Department attempts to inform county citizens of crimes in their area by reporting incidences to CrimeReports.com. Crime statistics are also published in annual reports. In 2016 the Sheriff's Office of Charles County reported 9,898 arrests, the lowest number of all 8 years shown in Table 3.3.11-1 (Charles County Sheriff's Office, 2016).

Table 3.3.11-1: Arrests in Charles County (Charles County Sherriff's Office, 2016)

YEAR	ARRESTS
2009	11,454
2010	11,746
2011	11,658
2012	11,416
2013	11,029
2014	11,600
2015	10,655
2016	9,898
Total	**89,456**

While there are few reports of civil disturbances in Charles County, political protesting is a rare occurrence. Crime in Charles County varies widely, including incidences of theft, vandalism, assault, and breaking and entering. The majority of these crimes are concentrated in and around the city of Waldorf; however, fewer occurrences have taken place in the Town of La Plata, Indian Head, and the Village of Port Tobacco. A large portion of these crimes are drug, liquor, or disorder related. Other crimes are considered property crimes, most of which were committed on residential or commercial property. Assault, assault with a deadly weapon, or sexual assault also occurred within the city of Waldorf and throughout Charles County.

Charles County officials have also developed the Charles County Crime Solvers program.

3.3.11.3 Future Occurrence

The Charles County Detention Center also has the potential for large-scale civil disorder, though this has never occurred to date. The Detention Center is located in the Town of La Plata on Route 301. Opened in 1995, it is a secure facility for incarcerated adults and houses 203 cells. Additionally, the Charles County Detention Center has an annex house for inmates on work release. The Corrections Division is accountable for the safety and custody of inmates, while also providing a variety of programs to help inmates re-enter society as more productive citizens through the reduction of recidivism.

Minor civil disturbances will continue to occur in Charles County, but it is not possible to accurately predict the probability and triggers for a large-scale civil disturbance event over the long-term. Local law enforcement will continue to anticipate these types of events and be prepared to handle a crowd so that peaceful gatherings are prevented from turning into unruly public disturbances. Therefore, the probability of civil disturbance occurring in Charles County is considered possible, yet unlikely. However, the probability of criminal activity occurring in Charles County is very likely. Taken together, the probability of civil disturbance and criminal activity as a combined hazard is considered *likely* (3 out of 4) as defined by the Risk Factor Methodology probability criteria.

3.3.11.4 Vulnerability Assessment

The vulnerability of communities to civil disturbance is difficult to determine because the hazard is typically tied to the current political and economic climate. The county and its jurisdictions may be very vulnerable one month and may be less vulnerable the next. Most civil disturbance events, should they occur, may have diminished impacts as a result of response training. Additionally, having adequate law enforcement can minimize the chances of a small assembly of people turning into a significant disturbance. In the case that a large civil disturbance event occurred, the County could incur losses related to work stoppages in addition to any acts of vandalism that may occur.

The county remains vulnerable to crime, although the crime rate in the County is down according to the most recent data. The continuation of programs such as CrimeReports and Crime Solvers can help citizens and local police work together towards deterring crime and increasing public safety.

3.3.11.5 Jurisdictional Differences

In general, only small and localized areas of Charles County are particularly vulnerable to civil disturbance events. Areas at higher risk include those near government facilities in La Plata, the Charles County Detention Center, the College of Southern Maryland, and other landmarks. On the other hand, all communities in Charles County are vulnerable on some level, directly or indirectly, to criminal activity. Historic records of crime indicate that the Waldorf area may be at a higher risk than other parts of the County.

3.3.11.6 Land Use and Development Trends

With increased development and population growth, the potential for civil disturbance and criminal activity could possibly increase. However, during the process of building and development, crime prevention can be encouraged through environmental design principles (National Crime Prevention Council, 2003). Future designs could incorporate the following:

- More lighting systems in public places
- Increased pedestrian and bicycle traffic
- Utilization of vacant land
- Increased video surveillance systems
- Increased Red Light Traffic Cameras
- Increased security of homes and commercial spaces

With the expected growth and development of Charles County, proper precautions can be made to discourage the likelihood of civil disturbances and criminal activity, including the aforementioned environmental design principles.

3.3.12 Dam Failure

The Dam Failure profile can be found in Appendix G.

3.3.13 Environmental Hazards

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Human-Made	4	1	1	4	2	**2.3**
MODERATE RISK (2.0 – 2.9)						

3.3.13.1 Location, Extent, and Range of Magnitude

This Environmental Hazards profile focuses on hazardous material releases and pipeline hazards. These events result from human activities and industries and can result in injury and death to humans and damage to property.

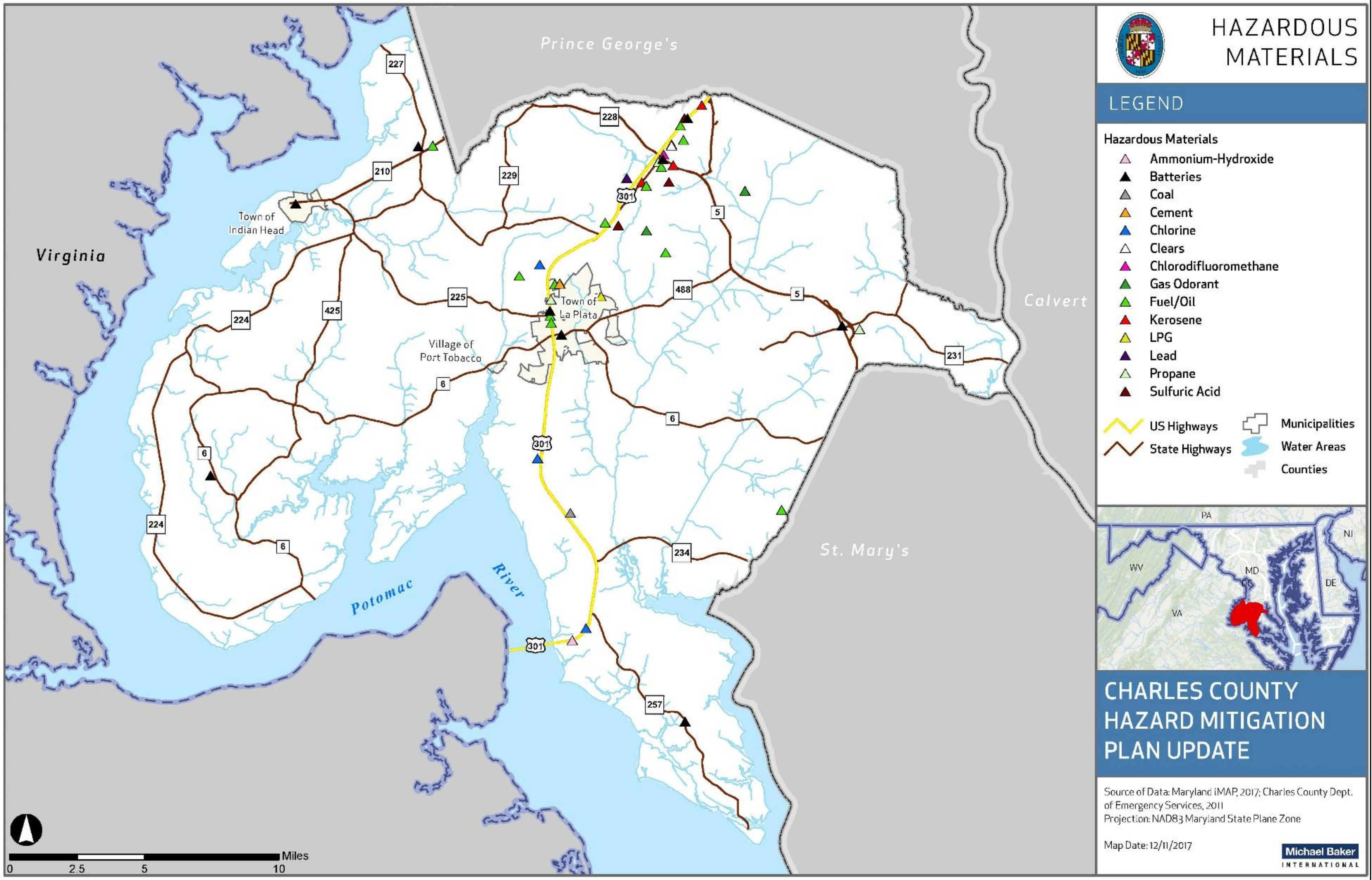
Hazardous Materials Release

A hazardous material release is the contamination of the environment (i.e. air, water, soil) by any material that because of its quantity, concentration, physical characteristics, or chemical characteristics threatens human, animal, or plant health, the environment, or property. Hazardous material spills are usually accidental events that arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. The consequences of such spills are usually unintended. An accidental or intentional release of hazardous materials could produce a health hazard to those in the area, downwind, and/or downstream with immediate, prolonged, and/or delayed effects. The spread of the material may additionally be defined by weather conditions and topography of the area. A hazardous materials release can come from a fixed facility or transportation. These events can also be intentional releases or acts of terrorism.

Fixed facilities housing hazardous substances in Charles County include water treatment plants, swimming pools, gas stations, and supply stores containing substances such as fuel, farm chemicals, propane, fuel oil, paint, and small amounts of chlorine. The locations of hazardous materials facilities throughout Charles County are shown in Figure 3.3.13-1. Most of these sites are clustered near U.S. 301.

A hazardous material release may also occur due to a transportation accident. There are increasingly large numbers of chemicals, oils, radioactive materials, and other hazardous substances spilled as the result of highway, rail, and waterway accidents, storage tank leakage, pipeline break, and/or other accidents. On occasion, these events become a major disaster and force people to evacuate and/or lose their homes and businesses. The most likely locations for a transportation-related hazardous material release are along the highways running throughout the County. Gas, propane, and other hazardous materials are delivered throughout the County year-round. The need for gas, propane, fertilizers, and other toxic materials in daily life creates a larger risk for a hazardous materials release.

Figure 3.3.13-1: Location of Hazardous Materials Facilities



A hazardous materials release in Charles County may not only contaminate dirt or surface material but could potentially contaminate flowing water in ditches, rivers, or small streams. Other potential concerns for spills/leaks are icy road conditions during winter months, sabotage, and terrorism. Dispersion can take place rapidly when transported by water and wind. While often accidental, releases can occur as a result of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, these incidents are known as secondary events. Hazardous materials can include toxic chemicals, radioactive materials, infectious substances, and hazardous wastes. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas. The environmental impacts of hazardous material releases include:

- Hydrologic effects, including surface and groundwater contamination.
- Other effects on water quality such as changes in water temperature.
- Damage to streams, lakes, ponds, estuaries, and wetland ecosystems.
- Air quality effects, including pollutants, smoke, and dust.
- Loss of quality in landscape.
- Reduced soil quality.
- Damage to plant communities, including loss of biodiversity and damage to vegetation.
- Damage to animal species, including animal fatalities, degradation of wildlife and aquatic habitat, pollution of drinking water for wildlife, loss of biodiversity, and disease.

With a hazardous material release, whether accidental or intentional, there are several potentially exacerbating or mitigating circumstances that will affect its severity or impact. Mitigating conditions are precautionary measures taken in advance to reduce the impact of a release on the surrounding environment. Primary and secondary containment or shielding by sheltering-in-place protects people and property from the harmful effects of a hazardous material release. Exacerbating conditions, characteristics that can enhance or magnify the effects of a hazardous material release are included below.

- **Weather conditions:** Affects how the hazard occurs and develops.
- **Micro-meteorological effects of buildings and terrain:** Alters dispersion of hazardous materials.
- **Non-compliance with applicable codes (e.g. building or fire codes) and maintenance failures (e.g. fire protection and containment features):** Can substantially increase the damage to the facility itself and to surrounding buildings.

The severity of the incident is dependent not only on the circumstances described above, but also with the type of material released and the distance and related response time for emergency response teams. The areas within closest proximity to the releases are generally at greatest risk, yet depending on the agent, a release can travel great distances or remain present in the environment for a long period of time (e.g. centuries to millennia for radioactive materials), resulting in extensive impacts on people and the environment.

Charles County has created a Tactical Response Team (TRT) to respond to hazardous materials releases 24/7 in the County. The need for the team came after 9/11 when the County realized most of the first responders were volunteers and would be called back to their full-time jobs as firefighters in the surrounding counties. The TRT is prepared to handle a myriad of hazardous materials releases at any time. The team responds to approximately 130 hazardous materials responses a year and utilizes National Capital Region FEMA training to respond to Chemical, Biological, Radiological, Nuclear, and enhanced (improvised) explosives threat (CBRNe) events throughout the region.

A worst-case scenario event of a hazardous material release would be if a release occurred in a very populated area, such as La Plata or Waldorf. A hazardous material release would likely cause the evacuation of community residents, visitors, and employees.

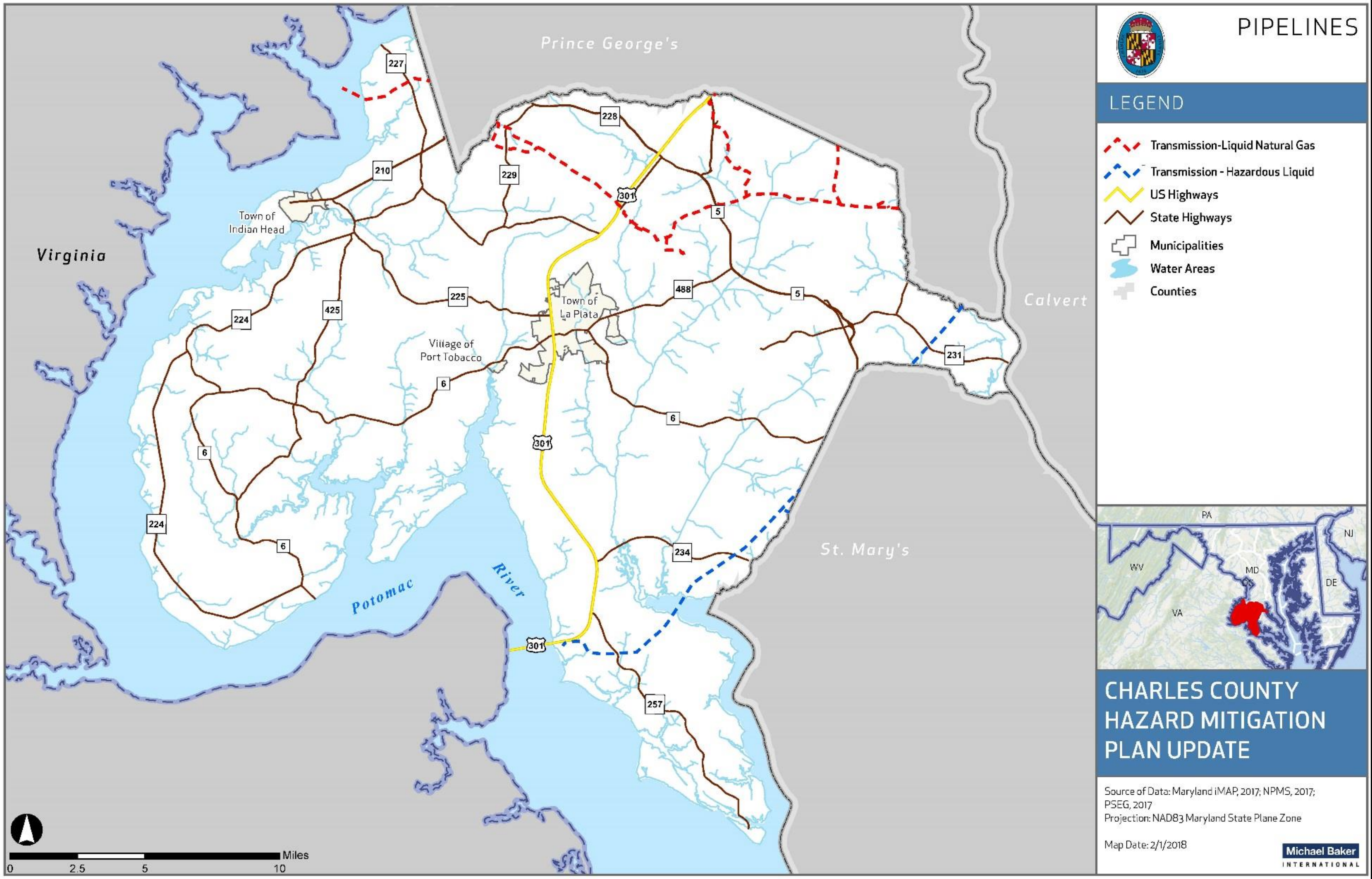
Pipeline Hazards

Transmission pipelines are often used as a preferred means to safely transport large quantities of energy products. In Charles County, there are several pipelines, including the CPV Maryland St. Charles Emergency Center (CPVSC) gas pipeline and the PSEG Keys Energy Center (PSEG) as pipeline. The CPVSC spans 1.5 miles, while the PSEG facilities pans 7.7 miles. Figure 3.3.13-2 shows the locations of pipelines in Charles County.

Pipelines safety standards are established within the US Code of Federal Regulations (CFR), Title 49 “Transportation,” Part 190-1999 with inspection and enforcement of these standards carried out by the Office of Pipeline Safety (OPS), within the US Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA). PHMSA estimates that gas transmission pipelines run through roughly 90% of all counties in the United States. Transmission pipelines are mostly buried underground and operated remotely from centrally-located control centers. According to PHMSA, the control centers allow for the efficient operation of either a single pipeline or a number of different pipeline systems from a single location. Pipeline control center operators can start and stop pumps, open and close valves, and control a number of other operational tasks task from a single location (US DOT-PHMSA). Pipelines are considered a relatively safe means of transporting crude oil or petroleum across the country; however, there have been pipeline incidents with catastrophic results. Such incidents can negatively impact nearby urbanized populations and contaminate critical or sensitive environmental areas. The great risk that pipelines present to the public include potential impacts from the unintentional release of the hazardous liquid or gas transmission product transported through the pipelines.

Precautionary measures are taken in advance to reduce the impact of a pipeline incident on the surrounding environment. For instance, pipeline operators are required to perform periodic surveys throughout their system. Additionally, emergency response plans must be developed for these facilities. For example, both the CPVSC and PSEG pipelines have Emergency Response Plans that outline various types of emergency situations and appropriate response procedures. Even with precautionary measures, it is difficult to predict the true risk that transmission pipelines present to a community.

Figure 3.3.13-2: Location of Pipelines in Charles County



The Dominion Compressor station also poses a potential threat to Charles County. The existing property in the Bryans Road section of the County is proposed to be upgraded to include a new station that will provide approximately 24,370 horsepower of compression to supply additional natural gas throughout Southern Maryland. The new station will be located on a 50-acre parcel that currently includes pipeline right-of-way, a maintenance building, and other equipment (Dominion Energy, 2017). Although pipelines can be a great economic benefit, the worst-case scenario for a transmission pipeline incident impacting a densely populated area could result in widespread injury, death, property damage, and environmental damage.

3.3.13.2 Past Occurrence

Hazardous Materials Releases

In 2017, there were 226 highway, railway, and aircraft-related hazardous material incidents totaling $168,746 in damages throughout Maryland (PHMSA, 2017). Other prior year incident information for Maryland can be found on the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration website.

The US EPA's Toxic Release Inventory (TRI) program, tracks hazardous materials release and disposal data for US counties and states. Since 1994, there have been no significant reported releases in Charles County. Additionally, Maryland ranks 31st nationwide based on total releases per square mile (EPA, 2016). However, the TRI does note many substances that have been safely disposed of in the County. Disposals include nitroglycerin, arsenic, chromium, manganese, mercury, nickel, nitric acid, sulfuric acid, and zinc. The TRI data does not provide data regarding the effect on the public of releases or disposals of hazardous materials; however, the US EPA TRI reports that there are five TRI sites in Charles County which produced 696.4 thousand pound of production-related waste that required disposal. Of these 696.4 thousand pounds, 18.4 thousand pounds were disposed of off-site.

Pipeline Hazards

There have been only four reported pipeline incidents in Maryland, three of which occurred in the 1970s and 1980s. The most recent event occurred on April 7, 2000 at the Piney Point Oil Pipeline, which was owned by the Potomac Electric Power Company. A pipe failure was experienced at the Chalk Point Generating Station in southeastern Prince George's County on the morning of the 7th, but the release was not discovered until the late afternoon. As a result, approximately 140,400 gallons of fuel oil were released into the surrounding wetlands and Swanson Creek. There were no injuries as a result of this event, but clean-up and environmental response operations cost approximately $71 million (NTSB, 2000).

3.3.13.3 Future Occurrence

Hazardous material release and pipeline incidents are generally considered difficult to predict. An occurrence is largely dependent upon the accidental or intentional actions of a person or group. It is difficult to predict when and where environmental hazards will arise as they are often related to equipment or technology failure and human error. Adequate monitoring through the MDE will reduce the likelihood of potential impacts to the community and to the environment; however it is still very likely that these events, particularly hazardous materials releases, will continue to occur. Based on historical data, hazardous materials releases occur hundreds of times annually throughout the state. Therefore, the probability of future environmental hazard events is considered *highly likely* (4 out of 4) as defined by the Risk Factor Methodology probability criteria.

3.3.13.4 Vulnerability Assessment

Hazardous Materials

Jurisdictions that are home to one or more hazardous materials facilities should be considered vulnerable to hazardous materials releases from fixed facilities. Table 3.3.13-1 shows the number of TRI facilities in Charles County. Three are located in unincorporated areas, while the remaining two are located in the Towns of La Plata and Indian Head. The jurisdictions and areas of the County without TRI facilities have much lower relative vulnerability to hazardous materials incidents at fixed facilities.

Table 3.3.13-1: TRI Facilities in Charles County (EPA, 2017)

TRI FACILITY	LOCATION	INDUSTRY
La Plata Ready Mix Concrete	La Plata	Nonmetallic Mineral Product
Morgantown Generating Station	Charles County Unincorporated (Newburg)	Electric Utilities
US Navy Naval Support Facility Indian Head	Indian Head	Other
Waldorf Marble Inc.	Charles County Unincorporated (White Plains)	Plastics and Rubber
Waldorf Plant	Charles County Unincorporated (Waldorf)	Nonmetallic Mineral Product

Critical facilities and populations located near TRI sites as shown in Table 3.3.13-7. Indian Head, La Plata, and unincorporated areas of the County all have critical facilities and populations located within 1.5 miles of a TRI facility. Indian Head is the jurisdiction most at risk to a hazardous materials release at a TRI facility, with 78% of critical facilities and over 50% of the jurisdiction's population located within 1.5 miles of the U.S. Navy Naval Support Facility. Overall, nearly 17% of critical facilities and 7.6% of the County's population are located near TRI facilities.

Table 3.3.13-2: Environmental Hazards (TRI facility) Vulnerability in Charles County

MUNICIPALITY	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES WITHIN 1.5 MI OF TRI FACILITY	PERCENT CRITICAL FACILITIES WITHIN 1.5 MI OF TRI FACILITY	TOTAL ESTIMATED 2010 POPULATION	POPULATION WITHIN 1.5 MI OF TRI FACILITY	PERCENT POPULATION WITHIN 1.5 MI OF TRI FACILITY
Charles County Unincorporated Areas	573	87	15.18%	134,384	8,539	6.35%
Town of Indian Head	23	18	78.26%	3,833	2,217	57.84%
Town of La Plata	82	10	12.20%	8,321	389	4.67%
Village of Port Tobacco	0	0	0.00%	13	0	0.00%
Total	**678**	**115**	**16.96%**	**146,551**	**11,145**	**7.60%**

All jurisdictions are also vulnerable to the impacts of hazardous materials releases during transportation. As shown in Table 3.3.13-8, over 35% of the County's population is located within 1.5 miles of major highways, including 100% of Port Tobaccos population and over 80% of the populations in both Indian Head and La Plata. Additionally, over 63% of critical facilities in the County are located in these areas and could be impacted by a release during transport.

Table 3.3.13-3: Hazard Materials Release (Transportation) Vulnerability in Charles County

MUNICIPALITY	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES WITHIN 1.5 MI OF HAZMAT RELEASE AREAS	PERCENT CRITICAL FACILITIES WITHIN 1.5 MI OF HAZMAT RELEASE AREAS	TOTAL ESTIMATED 2010 POPULATION	POPULATION WITHIN 1.5 MI OF HAZMAT RELEASE AREAS	PERCENT POPULATION WITHIN 1.5 MI OF HAZMAT RELEASE AREAS
Charles County Unincorporated Areas	573	346	60.38%	134,384	41,205	30.66%
Town of Indian Head	23	20	86.96%	3,833	3,115	81.27%
Town of La Plata	82	66	80.49%	8,321	7,139	85.79%
Village of Port Tobacco	0	0	0.00%	13	13	100.00%
Total	**678**	**432**	**63.72%**	**146,551**	**51,472**	**35.12%**

Hazardous materials incidents can pose a series of threats to human safety and welfare, as well as the environment. Incidents occur regularly, but are not often of a size to cause a significant threat. However, it seems likely that incidents will continue and the potential for a significant release is present. Incidents often occur in conjunction with, or as a result of, natural hazards impacting facilities that house hazardous materials. Depending upon the materials released, as well as atmospheric conditions, an incident has the potential to cause significant disruption to Charles County and its jurisdictions along with injury or even death to residents in the immediate area.

Figure 3.3.13-2: Household Hazardous Waste Brochure

Education is very important when it comes to hazardous materials mitigation. Workers should receive proper training in the use, safety, and regulations regarding hazardous materials. Workers and emergency response personnel should be trained in the appropriate techniques and safety measures for dealing with spills and incidents. The general public should be made aware of the hazards of household chemical products and of methods for properly disposing of these products. Charles County utilizes the Household Hazardous Waste Disposal Program that helps residents safely dispose of household hazardous chemicals and materials. Informational and educational materials are available on the County's website as well as in the brochure shown in Figure 3.3.13-2. In addition, numerous regulations and codes have been created to address containment, hazard communication, and controls. Hazardous materials are best managed through suitable containment. When properly contained, hazardous materials are unlikely to cause harm. The design of chemical containers for transportation and storage should be based on chemical and physical characteristics, the degree of hazard offered by the product, and to some extent on economic considerations. Most regulations and codes require containers to resist the most severe stresses that may reasonably be expected during normal handling, storage and use.

Hazard communication is also an important regulatory measure. As required by the United States Department of Transportation (USDOT) regulations, hazard communication information is provided in the form of container markings and labels, vehicle placarding, and shipping paper entries. Facilities are required to identify chemicals in buildings, tanks and other storage facilities using the (National Fire Protection Association) NFPA 704 system. USDOT regulations impose certain controls on the types of chemicals that may be shipped together, how they must be loaded and secured on vehicles, levels of allowable radiation exposure and radiological contamination and, for certain high level radioactive shipments, highway routing. Codes and zoning requirement may address allowable locations for chemical storage and use.

Pipeline Hazards

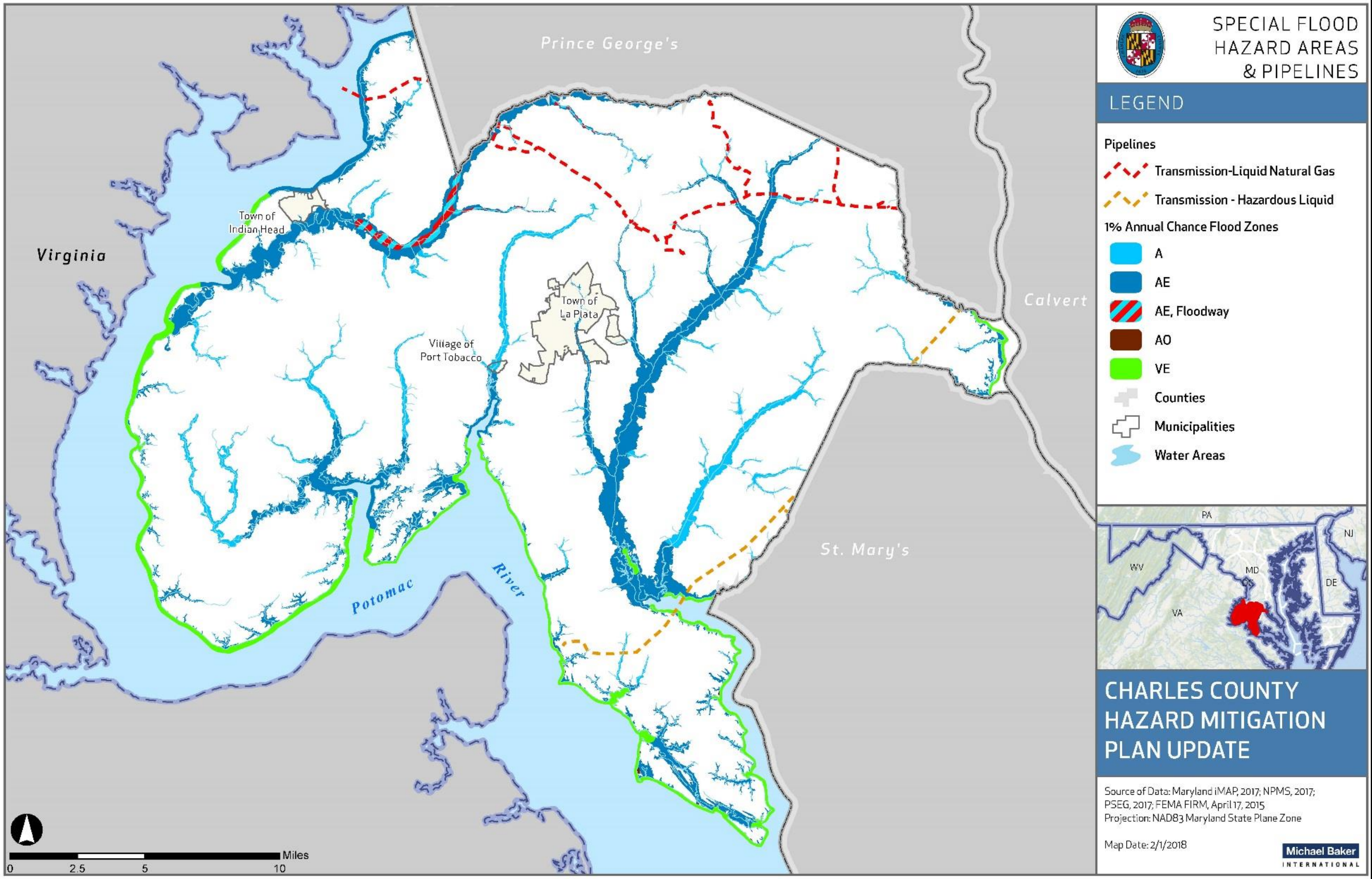
Pipeline systems are now considered by the Department of Homeland Security to be critical infrastructure under the transportation systems sector (US-DHS, 2016). While the likelihood of an emergency at a transmission pipeline in Charles County is difficult to determine, the likelihood is expected to increase as the transportation and distribution of energy products continues to increase.

Table 3.3.13-3 below shows critical facilities and populations that may be vulnerable to a transmission pipeline incident. Vulnerability is defined as living or being located with 0.25 miles of transmission pipelines that traverse Charles County. Roughly 22.37% of Charles County's population lives within 0.25 miles of transmission pipelines and are potentially vulnerable to the impacts of a transmission pipeline incident. Only the unincorporated areas of the County are vulnerable to this hazard. Approximately 116 or 16.96% of all critical facilities in the County are also located within this area. Similarly, only critical facilities in the unincorporated areas of the County are vulnerable.

Table 3.3.13-3: Pipeline Emergency Vulnerability

MUNICIPALITY	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES IN PIPELINE AREA	PERCENT CRITICAL FACILITIES IN PIPELINE AREA	TOTAL ESTIMATED 2010 POPULATION	POPULATION IN PIPELINE AREA	PERCENT POPULATION IN PIPELINE AREA
Charles County Unincorporated Areas	573	115	20.07%	134,384	32,788	24.40%
Town of Indian Head	23	0	0.00%	3,833	0	0.00%
Town of La Plata	82	0	0.00%	8,321	0	0.00%
Village of Port Tobacco	0	0	0.00%	13	0	0.00%
Total	**678**	**115**	**16.96%**	**146,551**	**32,788**	**22.37%**

Figure 3.3.13-3:Location of Pipelines and SFHA in Charles County



Flooding and other hazards could also potentially damage pipelines and increase the risk of a pipeline failure or release of materials. Figure 3.3.13-3 shows the locations of pipelines and the SFHA in Charles County.

3.3.13.5 Jurisdictional Differences

As state highway and railway corridors cross through and around Charles County, all jurisdictions in the County could potentially be affected by a hazardous materials release. Additionally, populations and critical facilities in Indian Head, La Plata, and unincorporated areas of the County are located near TRI facilities and are therefore potentially more vulnerable to a hazardous materials release at a fixed facility. For pipeline emergencies, only unincorporated areas of the County are currently vulnerable, although future expansions of pipelines could cause other jurisdictions could become vulnerable to this hazard.

3.3.13.6 Land Use and Development Trends

Population impacts are often greater than the structural impacts during an environmental hazard event, and as a result, more densely populated areas of the County would be impacted more significantly during such an event. Development codes and zoning requirement may address allowable locations for chemical storage and use, although as the population increases, development will also continue to increase in nearby areas thereby exposing a greater number of individuals to the risk of a hazardous materials release. Zoning regulations can also be used to limit the extent of development and population densities near pipelines.

3.3.14 Nuclear Events

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Human-Made	1	2	1	2	4	**1.7**
LOW RISK (Less than 2.0)						

3.3.14.1 Location, Extent, and Range of Magnitude

The State of Maryland's Radiological Incident Annex, dated July 2010, defines Fixed Nuclear Facilities (FNF) as sites where nuclear materials are employed in an operation (i.e., nuclear reactors) or in storage which could cause an emergency nuclear incident. An emergency nuclear incident always coincides with a **radiation incident,** which the Radiological Incident Annex defines as any event involving radiation exposure or radioactive contamination to the public (U.S. Nuclear Regulatory Commission, 2017).

The areas surrounding FNFs are known as ingestion zones, since those areas are most likely to absorb radiation if it were released from an FNF. **Ingestion zones** are defined as having a radius of about 50 miles for commercial nuclear reactors and a radius of about 5 miles for research reactors. Within ingestion zones, **plume zones** are designated as having a radius of about 10 miles for commercial nuclear reactors and about 1 mile for research reactors.

Radiation is defined generally as energy given off by matter in the form of rays or high-speed particles. While there are many non-hazardous forms of natural radiation that citizens encounter daily, some forms of radiation can be dangerous when uncontrolled. Radiation can be dangerous to humans when exposed to dosages of 200 rad or more. **Rads** are units of measurement for the amount of ionized radiation that enters the body. The US Nuclear Regulatory Commission requires the use of the units "curie", "rad" and "rem" as part of the Code of Federal Regulations 10 CFR 20.

The most common types of radiation are alpha, beta, and gamma rays—although other types do exist. **Alpha** particles are formed by two protons and two neutrons and are considerably larger than any other radiation particles (over 7,000 times larger than beta rays). Due to their mass, alpha particles have a relatively short range. In fact, human skin is able to keep alpha particles from entering the body in most cases. While humans that come into external contact with alpha particles are unlikely to face harm, the ingestion, inhalation, or absorption into the bloodstream of alpha particles can be very dangerous. When internalized, alpha particles damage cells and are known to cause cancer later in life.

Beta particles are extremely small and rapidly moving. Low mass and high speed makes beta particles more of a threat to penetrate the human body and cause harm. In open air, beta particles can travel several feet but are easily stopped by solid materials. Exposure to beta particles externally will cause a burn on the skin similar to sunburn. When inhaled, ingested, or absorbed into the bloodstream, beta particles damage cells and result in radiation sickness and cancer later in life.

Gamma particles have no mass and no charge. Gamma rays consist of pure electromagnetic energy that move at the speed of light. Since they have no mass, in open air gamma rays can travel tens of miles before dispersing. Although they are generally classified as an external hazard; gamma-emitting radionuclides can also be inhaled, or ingested with water or food, and cause exposures to organs inside the body. In large exposures, radionuclides can cause radiation sickness and even immediate death. Table 3.3.14-1 below displays health effects in relation to time of radiation exposure.

Table 3.3.14-1: Health Effects with Exposure to Radiation

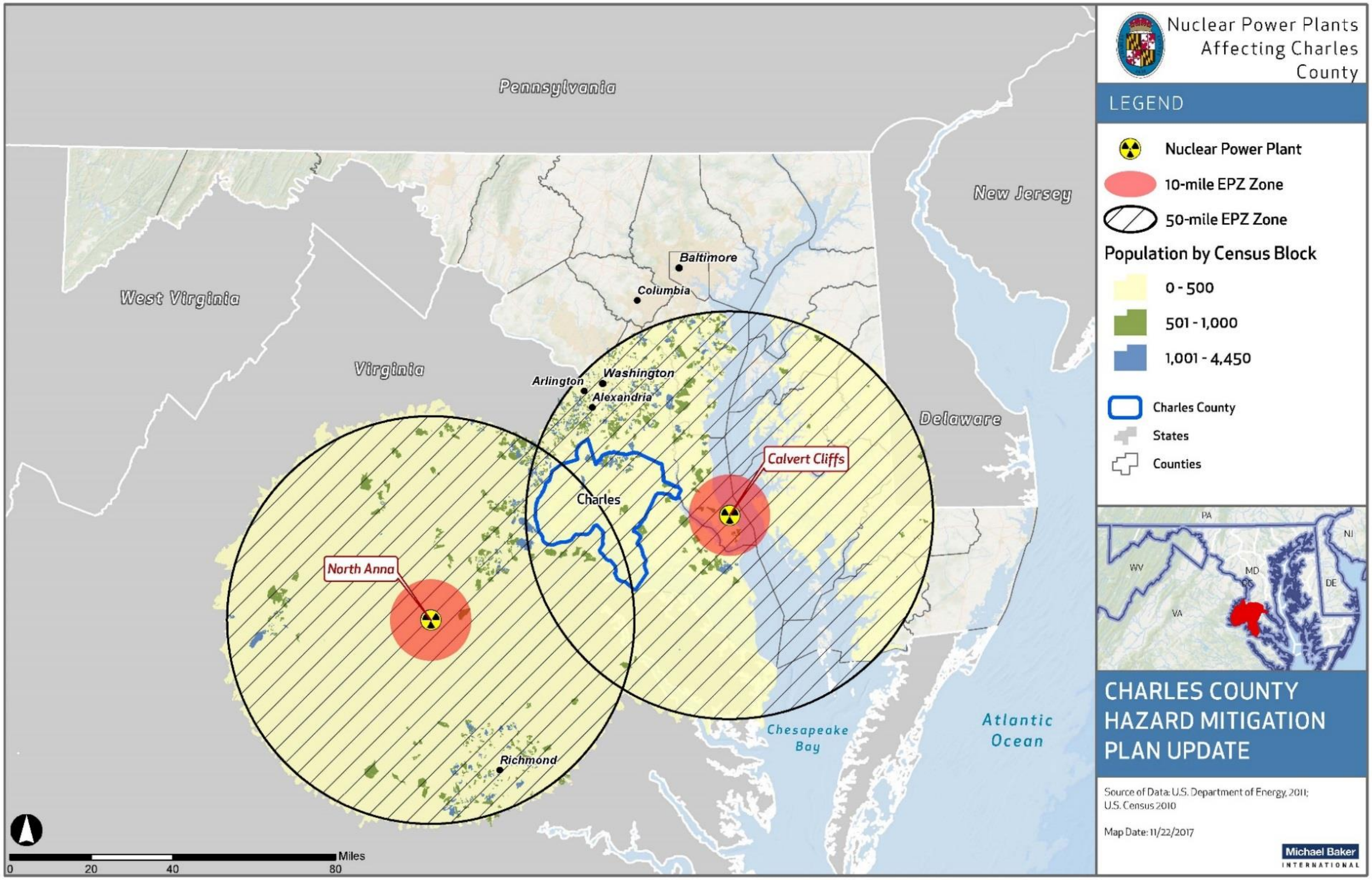
EXPOSURE (RADS)	HEALTH EFFECTS	TIME TO ONSET (WITHOUT TREATMENT)
5-10	Changes in blood chemistry	
50	Nausea	Hours
55	Fatigue	
70	Vomiting	
75	Hair loss	2-3 weeks
90	Diarrhea	
100	Hemorrhage	
400	Possible death	Within 2 months
1,000	Destruction of intestinal lining	
	Internal bleeding	
	Death	1-2 weeks
2,000	Damage to central nervous system	
	Loss of consciousness	Minutes
	Death	Hours

Given the instance of a nuclear incident there are three factors which can limit the amount of radiation one receives from an unshielded source: time, distance, and shielding.

- **Time:** While there is no technically “safe” amount of radiation, limiting the amount of time an individual is exposed to radiation can decrease chances of ill effects. For instance, an individual having an x-ray taken is subjected to three to four times as much radiation as is naturally occurring; however, the x- ray is extraordinarily brief and unlikely to cause lasting effects.
- **Distance:** As mentioned in the descriptions of alpha, beta, and gamma particles, different types of radiation can travel different distances (alpha the shortest distance and gamma particles the furthest) before expending all their energy. Thus, increasing the distance between unshielded radiation and humans is a very effective method of prevention.
- **Shielding:** Depending on the thickness of the barrier, shielding exponentially blocks or reduces radiation pathways. For example, lead is commonly used to block or reduce radiation pathways due to its extreme density, which keeps particles from penetrating the shield (US EPA, 2017).

Charles County is located within 50 miles of two FNFs: the Calvert Cliffs Nuclear Power Plant in Maryland and the North Anna Power Station in Virginia. Considering both FNFs are active and contain radionuclides, Charles County is within the ingestion exposure zones for both facilities. Please refer to the Figure 3.3.14-1 for the location of these facilities in relation to Charles County.

Figure 3.3.14-1: Nuclear Power Plants Affecting Charles County



Although very rare, an accident at either FNF could result in dangerous levels of radiation that could affect the health and safety of the public located within the ingestion exposure zones. The risk of accidental release at each FNF is calculated by the US Nuclear Regulatory Commission (NRC) using the “probabilistic risk assessment “(PRA) method. Since both Calvert Cliffs and North Anna Nuclear Power Stations use pressurized water reactors (PWR), both facilities have similar risks of failure. The risk for PWR core damage is approximately 30% over 20 years. However, this number does not include containment failure, which is estimated by the NRC at 8% annually for PWR (US NRC, 2016).

Although currently unreleased, the NRC is developing a new risk modeling system for nuclear reactors called State-of-the-Art Reactor Consequence Analyses (SOARCA). SOARCA’s objective is to develop updated and more realistic analyses of severe reactor accidents by including significant plant changes and updates (e.g., system improvements, training and emergency procedures, and offsite emergency response) that plant owners have made, which were not reflected in earlier assessments conducted by the U.S. Nuclear Regulatory Commission (NRC). These plant changes also include recent enhancements since the terrorist attacks on September 11, 2001. Additionally, recent seismic activity in the mid- Atlantic region has caused many FNF to revisit plans and training for FNF automatic shutdowns when earthquakes occur. While the likelihood of a release of radiation from a nuclear reactor is very low, the cascading damages and consequences of a release of radiation are extremely severe, especially regarding decontamination of persons, buildings, infrastructure, and roadways.

Nuclear accidents themselves are classified into three categories:

- **Critical accidents:** Involves loss of control of nuclear assemblies or power reactors.
- **Loss-of-coolant accidents:** Occurs whenever a reactor coolant system experiences a break or opening large enough so that the coolant inventory in the system cannot be maintained by the normally operating make-up system.
- **Loss-of-containment accidents:** Involves the release of radioactivity from materials, such as tritium, fission products, plutonium, and natural, depleted, or enriched uranium. Points of release have been containment vessels at fixed facilities or damaged packages during transportation accidents.

Nuclear facilities must notify the appropriate authorities in the event of an accident. The Nuclear Regulatory Commission uses four classification levels for nuclear incidents (Nuclear Regulatory Commission, 2008):

- **Unusual Event:** Under this category, events are in process or have occurred which indicate potential degradation in the level of safety of the plant. No release of radioactive material requiring off-site response or monitoring is expected unless further degradation occurs.
- **Alert:** If an alert is declared, events are in process or have occurred which involve an actual or potential substantial degradation in the level of safety of the plant. Any releases of radioactive material from the plant are expected to be limited to a small fraction of the EPA Protective Action Guides (PAGs).

- **Site Area Emergency:** A site area emergency involves events in process or which have occurred that result in actual or likely major failures of plant functions needed for protection of the public. Any releases of radioactive material are not expected to exceed the EPA PAGs except near the site boundary.
- **General Emergency:** A general emergency involves actual or imminent substantial core damage or melting of reactor fuel with the potential for loss of containment integrity. Radioactive releases during a general emergency can reasonably be expected to exceed the EPA PAGs for more than the immediate site area.

Additionally, recent seismic activity in the mid-Atlantic region has caused many FNFs to revisit plans and training for FNF automatic shutdowns when earthquakes occur. While the likelihood of a release of radiation from a nuclear reactor is very low, the cascading damages and consequences of a release of radiation are extremely severe, especially regarding decontamination of persons, buildings, infrastructure, and roadways.

Injured people will require some decontamination during medical treatment and is likely required prior to hospital admission. Thousands more will likely need superficial decontamination, and both short-term and long-term medical follow-ups to check for signs of cancer or other ailments associated with the unintended release of radiation.

Radioactive contamination will settle on streets, sidewalks, and building surfaces. Depending on the type of building materials, radiation might form a tight bond to stone and concrete that is resistant to simple rinsing. Personal items including clothing and jewelry will likely be contaminated and require forfeiture. While the exterior of vehicles may be decontaminated by simply rinsing with soap and water, the interior of vehicles will be much harder to clean and the cost of doing so may be prohibitively expensive.

Some demolition will likely be required, but most surfaces may be systematically decontaminated to low levels (a lengthy, costly process). It is most likely that decontamination will be focused primarily on critical infrastructures – such as major thoroughfares, public transportation, sewers, and water treatment facilities in order to restore basic functions as quickly as possible. Streets may need to be repaved or “capped” to trap radioactive contamination. Most sidewalks in the ingestion zone will need to be cleaned or capped. In addition, roofing materials will most likely need to be removed and/or resurfaced.

Contaminated exterior surfaces will need to be decontaminated with an assortment of chemical treatments (e.g., stripping, vacuum blasting, scabbling), and collected wastes will need to be hauled off for disposal. Contaminated building interiors will require removal of surface coatings, carpet, drapery, furniture, etc., and will need to be largely refurbished.

The waste caused by decontamination work is a concern. Workers can try to capture decontamination wastes for disposal, but much will escape into storm drains with each spring rain, causing sewers to become (further) contaminated. Some wastewater and sewage drains may be cleaned when “hot spots” of contamination are identified, but others may be left fairly contained if cleaning is not justified. It is also possible, though concentrations are low, river sediment remediation may be required.

3.3.14.2 Past Occurrence

The accident at the Three Mile Island Generating Station in March 1979 remains the nation's only nuclear incident at the General Emergency level and remains the worst nuclear incident on record in the nation. During this incident, equipment malfunctions, design-related problems, and worker errors led to a partial meltdown of the TMI Unit 2 reactor core at TMI.

3.3.14.3 Future Occurrence

Overall, the probability of a future nuclear incident event is unlikely (1 of 4) according to the Risk Factor Methodology. However, while the nuclear hazard is the most unlikely to be experienced, it is also the most severe. The Emergency Notification Network (ENN) will be used to provide warnings regarding a nuclear power plant emergency, and the Emergency Alert System (EAS) and the Citizen's Notification Service (CNS) will be used to notify the general public of emergency condition. The county Warning Point maintains a capability to use a wide variety of radio systems and networks to provide a county-wide emergency warning system including the 800 MHz, VHF and UHF radio systems, satellite communications, and amateur radio operator (MEMA, 2008).

3.3.14.4 Vulnerability Assessment

The effects and impacts of a nuclear/radiological threat depend on the type of radiation released, the duration of the release, the volume of the release, and the existing weather conditions, such as wind speed and direction. Charles County is located entirely within the 50-mile Ingestion Exposure Pathway for Calvert Cliffs Nuclear Power Plant and partially within the pathway for the North Anna Power Station. The worst case radiological release event for Charles County would be a major release of radioactive material from the Calvert Cliffs Nuclear Power Plant. This event could generate a great deal of fear for residents of Charles County and the surrounding region. Specific impacts would depend on the extent and spread of the contamination, although it would likely affect the Chesapeake Bay near Lusby, Calvert County, Maryland. Although FNFs have an extraordinarily safe operating history in the United States, their existence creates the potential for a release, spill, loss, theft, or other incidents that could occur during the storage, transportation, use, or misuse of radionuclides designated as hazardous substances.

A major release of radiation into either ingestion exposure pathways would result in potentially catastrophic damages. All buildings in the ingestion zone are at risk for contamination. Negative indoor building pressure draws radioactive aerosols into buildings via cracks around windows and doors. Exterior air intakes increase the contamination in the interior of larger buildings. In populated areas, foot and vehicular traffic after deposition re-suspend and transfer contamination for hours afterward until the entire scene has been effectively controlled and cordoned, contributing to contamination spread beyond the expected ingestion zone. Individuals in the deposition zone will likely transfer contamination to their residences in their hair and clothing.

Sewage and water treatment facilities, along with other critical infrastructure will likely need to be decontaminated at costs that are unpredictably high. Roadways will likely need to be resurfaced or capped to prevent further contamination. Charles County's government vehicle fleet could be contaminated and require extensive and costly decontamination or replacement. The current healthcare system and number of hospital beds will be inadequate to sufficiently handle the number of patients, worried well, and family members, which would quickly stress and overwhelm current resources.

While a nuclear event is the most unlikely hazard to be experienced, it could also be the most severe hazard in terms of consequence, immediate damages, cascading damages, and long-term negative effects on citizens, government, critical infrastructure, housing, healthcare, political institutions, and the private sector. Developing a hazard mitigation plan, understanding nuclear/radiological risk, and identifying future opportunities for training, exercises, and familiarization with state and Federal response agencies is the industry best practice for preparing for the response to and recovery from nuclear hazards. While most hazards are handled entirely at the local level, the response to a hazard of this type is inherently massive and automatically triggers widespread responses from the State of Maryland and dozens of Federal agencies. In order to improve preparedness, continued coordination and future trainings with the aforementioned entities is crucial.

3.3.14.5 Jurisdictional Differences

The entirety of Charles County falls within the 50-mile Ingestion Exposure Pathway for Calvert Cliffs Nuclear Power Plant, and the western portion of the County is also located within the pathway for the North Anna Power Station. While there is not a significant distinction in risk for any specific jurisdictions within Charles County since the severity of a radiation incident will be dictated by the weather (direction of wind, wind speed, humidity, etc.), the western portion of the County, including the Town of Indian Head, may be slightly more vulnerable because it is located in two Ingestion Exposure Pathways as opposed to just one. More densely populated areas will also pose challenges to wind/dispersal modeling due to complex urban wind patterns.

3.3.14.6 Land Use and Development Trends

In general, any new development and increases in population will increase the number of people and assets in Charles County that are at risk to a nuclear event; however, the specific location of future development and population growth centers will have little impact on vulnerability to this hazard since the entire county is at-risk.

3.3.15 Public Health Emergencies

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Human-Made	4	3	2	1	4	**3.0**
HIGH RISK (3.0 or higher)						

3.3.15.1 Location, Extent, and Range of Magnitude

A public health emergency may be defined as an event, either natural or manmade, that creates a significant health risk to the public. Public health emergencies can result from a number of causes, take many forms, and be spread by various means. Due to the nature of public health emergencies, impacts from such an event tend to be more widespread rather than confined to a specific location. A public health emergency can originate outside of Charles County, yet impact communities within the county.

Table 3.3.15-1: Public Health Emergencies that are Possible Threats

AREAS OF CONCERN	EXAMPLE
Agro-terrorism	The deliberate introduction of an animal or plant disease with the goal of generating fear, causing economic losses, and/or undermining stability. Agro-terrorism can be considered a subcategory of bioterrorism and foodborne diseases.
Bioterrorism	The intentional or deliberate use of germs or biotoxins that cause disease or death in people, animals, or plants. Examples include Salmonella, and E.coli or other agents that cause anthrax, smallpox, or botulism.
Chemical terrorism	The deliberate use of manufactured chemicals, whether they were created intentionally as weapons or for industrial purposes, in order to cause illness or death. Examples include sarin and chlorine.
Chemical incidents and accidents	The non-deliberate exposure of humans to harmful chemical agents, with similar outcomes to chemical terrorism.
Foodborne diseases	Foodborne illness is caused by ingestion of harmful microbes or the toxins they produce. The Centers for Disease Control and Prevention (CDC) estimates there are approximately 76 million pathogen-induced cases of food-borne disease each year in the United States causing approximately 325,000 hospitalizations and 5,000 deaths. Examples include botulism, Salmonella, E.coli 0157:H7, shigella, and norovirus.
Influenza pandemic	An epidemic of a flu virus that spreads worldwide and infects a large proportion of the human population.

Table 3.3.15-1: Public Health Emergencies that are Possible Threats	
AREAS OF CONCERN	EXAMPLE
	Influenza pandemics occur when a new strain of the flu virus is transmitted to humans from another animal species, like pigs, chickens, or ducks. Humans do not have natural immunity against these new strains. The H1N1 flu virus was the first pandemic flu of the 21st century. Historically, pandemic flu occurs two to three times every 100 years or so. During the 20th century the world experienced three pandemic flu events; 1918, 1957/58, and 1968. The severity of disease varied greatly among them.
Natural disasters	Although not classified public health emergencies themselves, damage from natural disasters can lead to contaminated water, shortages of food and water, loss of shelter, and the disruption of health care services, each of which have the ability to become public health emergencies within the affected community.
Radiological threats	Intentional or accidental exposure to radiological material. Examples include radioactive materials dispersed through the use of explosives (“dirty bomb”), an accident at a nuclear power facility, the introduction of radioactive materials into a food or water supply, or the explosion of a nuclear device near a population center.
Vector-borne diseases	Disease spread by vectors, such as insects and ticks. Examples include West Nile virus, Dengue fever, Rocky Mountain spotted fever, malaria, and ZIKA virus. In 2015/2017, ZIKA virus, a virus carried by mosquitoes, spread to dozens of countries, infected thousands resulting in birth defects in some cases, and contributed to worldwide travel warnings that included several communities in both Florida and Texas.
Water-borne diseases	Diseases spread by contaminated drinking water or recreational water. According to the CDC, more than 1,000 persons become ill from contaminated drinking water and more than 2,500 persons become ill from recreational water disease outbreaks annually in the United States.
Zoonotic/Animal-borne diseases	Animal diseases that can spread to humans and, in some cases, become contagious from human to human.

Table 3.3.15-1: Public Health Emergencies that are Possible Threats	
AREAS OF CONCERN	EXAMPLE
	Examples include Avian flu, Swine flu, Ebola, and SARS. In 2000, the World Health Organization (WHO) identified more than 200 diseases occurring in humans that were known to be transmitted through animals. Population displacement, urbanization and crowding, deforestation, and globalization of the food supply are all factors believed to contribute to the increase in the emergence of zoonotic diseases worldwide.

In the event of a public health emergency, the mission of the Charles County Department of Health is to preserve life, minimize risk, investigate threats, maintain surveillance systems, coordinate medical and mental health care, provide health-related information, provide essential public health functions, and maintain/create safe public environments.

Influenza Response Activities

Flu seasons occur each year with varying severity. Estimates of influenza-associated deaths range from a low of about 3,350 to a high of 48,614 people in the United States per year. Pandemics happen when a new (novel) influenza A viruses emerge which are able to infect people easily and spread from person to person in an efficient and sustained way.

Table 3.3.15-2: Estimated Health Impact of Pandemic Influenza in Charles County (based on an estimated population of 157,705)			
CHARACTERISTICS	MODERATE SEVERITY	HIGH SEVERITY	VERY HIGH SEVERITY
	< 20% attack rate	30% attack rate	50% attack rate
Illness	31,541	47,312	78,853
Outpatient Care	15,771	23,656	31.541
Hospitalization	142	442	5,204
ICU Care	22	77	789
Ventilation	110	33	378
Deaths	8	108	994

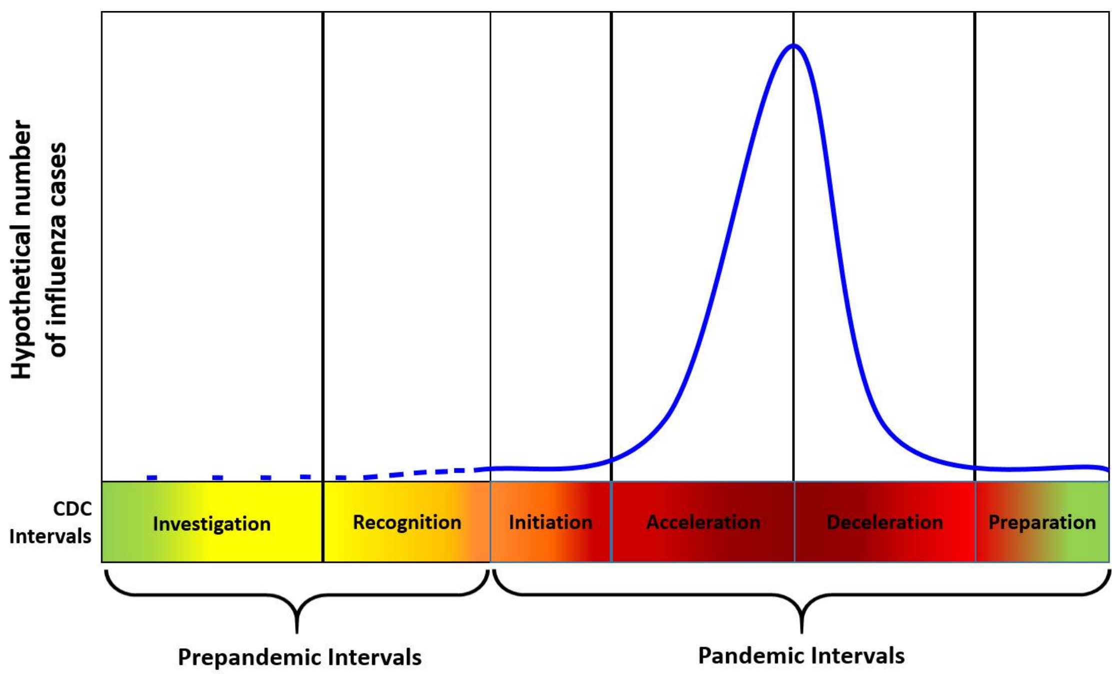
There are several characteristics of an influenza pandemic that differentiate it from other public health emergencies. First, it has the potential to suddenly cause illness in a very large number of people, who could overwhelm the health care system throughout the nation. A pandemic could also jeopardize essential community services by causing high levels of absenteeism in critical positions in every workforce. It is likely that vaccines against a new virus will not be available for six to eight months following the emergence of the virus. Basic services, such as health care, law enforcement, fire emergency response, communications, transportation, and utilities, could be disrupted during a pandemic. Finally, a pandemic could last for several weeks, if not months.

Year-round seasonal influenza activities provide the foundation for any influenza pandemic response. Surveillance and monitoring, research and development, delivery of Medical Countermeasures (for example, vaccines and therapeutics, diagnostics, and respiratory protective devices) and non-pharmaceutical interventions, health care system response, and public communication are integral to the objectives of the U.S. Department of Health and Human Services' (HHS) Pandemic Influenza Plan 2017 update.

HHS has developed three tools to assess the risk and potential public health impact posed by an emerging virus, estimate the possible progression of the event, and evaluate its severity and transmissibility to help guide different aspects of planning and response.

The Pandemic Intervals Framework (PIF) defines and describes six time intervals of an influenza pandemic, including indicators signaling each interval and recommended interventions. These intervals provide a common method to describe pandemic activity which can inform public health actions. The duration of each pandemic interval might vary depending on the characteristics of the virus and the public health response.

Figure 3.3.15-1: Pandemic Intervals Framework



The Pandemic Severity Assessment Framework (PSAF), is a systematic framework for assessing the public health effects of an emerging pandemic. It helps to identify the type and timing of actions needed for effective intervention and guide the development of operational plans and guide response efforts. The Influenza Risk Assessment Tool (IRAT) assess the potential human pandemic risk of novel influenza A viruses to inform decisions regarding the development, manufacturing, use and stockpiling of diagnostics, vaccines, and therapeutics.

The Opioid Crisis

On March 1, 2017, Maryland Governor Larry Hogan declared a state of emergency in response to the opioid crisis in Maryland. Over the past several years Maryland and much of the country, has seen a ever-increasing rise in the growth of opioid addiction and overdose deaths placing a severe strain on emergency services and public health.

Opioids are a class of medication that reduce pain by acting upon receptors in the brain and spinal cord (also known as analgesics). Opioids include heroin and prescription opioid drugs such as oxycodone, hydrocodone, hydromorphone, methadone, tramadol and codeine, and prescribed and illicit fentanyl. Opioids are used in the medical treatment of severe, acute pain. Opioids are also highly addictive when used over a long period of time.

Heroin and fentanyl killed 1,468 Maryland residents in the first nine months of 2016, up 70% from the same period in 2015. The emergency declaration provides local agencies the ability to access valuable resources in an effort to improve prevention, treatment, and recovery support services.

3.3.15.2 Past Occurrence

Charles County has faced numerous public health emergencies in the past. In 2009, the County responded to the first pandemic of the 21st century, the H1N1 influenza virus. The first case of H1N1 reported in the County was in April of 2009. Data from the Charles County Department of Health indicated that two peak periods of influenza infection occurred in June and October 2009.

The Charles County Department of Health also provided a listing of other events that have had a public health impact in the County since 2011. Eight events, ranging from small localized disease outbreaks to global infectious disease outbreaks which affected the local population, livestock, businesses, and county fairs are summarized in the following table.

Table 3.3.15-3: Significant Public Health Events Since 2011 (Charles County Department of Health, 2017)

DATE	EVENT	IMPACT
5/3/2012	Tuberculosis (TB) Outbreak	Local/Regional: Locally this impacted 327 High School Students
7/15/2012	Rabies/Bats	Local: Multiunit apartment complex
8/30/2012	H3N2 Flu Variant - Pigs	MD/Regional: Affected swine entrants at the Charles County Fair
9/26/2014	Emerging Infectious Disease Outbreak - Ebola	National/Worldwide: Travel restrictions and heightened disease surveillance
2015-2016	Emerging Infectious Disease Outbreak-Zika	National/Worldwide: Travel precautions and local response teams.
11/11/2016	Tuberculosis (TB) Outbreak	Local/Regional: High school students and local community organization
8/2017	Disease Outbreak – Hepatitis A	Regional: Smoothie Franchise

Table 3.3.15-3: Significant Public Health Events Since 2011 (Charles County Department of Health, 2017)		
DATE	EVENT	IMPACT
9/17/2017	H3N2 Flu Variant-Pigs	Regional: 40 human cases and three county fairs impacted.

3.3.15.3 Future Occurrence

All communities face a broad range of natural and manmade hazards that can threaten the public's health and safety. Public health departments across the country have been tasked with developing plans for coordinated response to these hazards. Public health emergencies are difficult to predict. A wide range of causes can result in varying levels of severity and the impact a particular hazard may have on a local population, thus making it difficult to establish a frequency of occurrence.

3.3.15.4 Vulnerability Assessment

The public health role of preparing for and responding to emergencies has expanded in the face of massive impacts from recent disasters and emerging infectious disease outbreaks. The Division of Preparedness and Response Services of The Charles County Department of Health was established in 2002 in response to the U.S. Centers for Disease Control and Prevention's (CDC) Public Health Emergency Preparedness (PHEP) grant requirements. The Public Health Preparedness program is structured around 15 capabilities, providing a template for effective response planning and mitigation strategies.

The Division of Preparedness and Response Services provides an important core public function and is committed to strengthening the jurisdictions' health security by preparing for, responding to, and recovering from public health emergencies, natural or man-made, and being part of a system for community resiliency.

The focal point of Public Health Preparedness revolves around planning for mass vaccination and pharmaceutical dispensing campaigns in the event of a large-scale public health emergency, such as an outbreak of a highly contagious disease. This type of planning requires a great deal of collaboration with local community stakeholders as well as numerous jurisdictional healthcare partners.

The Division of Preparedness and Response participates as a member of the Region V Emergency Preparedness Coalition, which is made up of representatives from hospitals, public health, and other healthcare agencies within Montgomery, Prince George's, Calvert, Charles, and St. Mary's counties. The Division also represents the county as a member of the National Capital Region Council of Governments Public Health Emergency Planners sub-committee. These and other local planning groups work to continuously improve health and medical system emergency preparedness through planning, training, drills and exercises, and policy development.

The assessment and prioritization of health hazards is an ongoing process. Changes in population, demographic, environmental and disease specific risk factors, as well as improvements in planning, training, exercising and mitigation based activities conducted by the department alter the risk relationship.

3.3.15.5 Jurisdictional Differences

All communities in Charles County are considered vulnerable to public health emergencies, with the likely greatest impact in terms of population affected and disruption of economic activity occurring in more densely populated communities such as the towns of La Plata and Indian Head. The College of Southern Maryland in La Plata may also be at a higher risk due to the high concentration of students.

3.3.15.6 Land Use and Development Trends

Because proximity is a major factor in how diseases and illnesses spread, changes in population, demographics, and density may influence the impact of an outbreak, epidemic, or pandemic. Any significant development in Charles County could potentially impact how susceptible the County is to a widespread disease or public health emergency.

3.3.16 Transportation Accidents

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Human-Made	4	2	1	1	1	**2.2**
MODERATE RISK (2.0 – 2.9)						

3.3.16.1 Location, Extent, and Range of Magnitude

For the purposes of this plan, transportation accidents are defined as incidents involving highway, air, and rail travel. According to the Maryland Department of Transportation's State Highway Administration, there is a total of 1,019 linear miles of highway, including 46.8 miles of local municipal roadways within Charles County, 770.1 miles of County highway, and 202.1 miles of state highway (SHA, 2017). There are no U.S. interstate highways that pass through Charles County, but U.S. Route 301 does run from the northeast part of the County, through the Town of La Plata, and across the Potomac River into Virginia. Charles County is crossed by several major road networks, and transportation accidents involving those networks can have impacts on secondary roads.

Figure 3.3.16-1 shows the road network in Charles County and the average annual daily traffic on those roads from 2016. The most heavily traveled roads are US Highway 301, State Highway 228, and State Highway 5. Major transportation corridors are more vulnerable to transportation accidents, especially in areas where the daily traffic counts are greatest.

At a minimum, transportation accidents can result in damage to the vehicles and minor injuries to passengers and drivers. At worst, significant transportation accidents can result in death or serious injury or extensive property loss or damage coupled with business interruptions and hours of congestion. Road and railway accidents in particular have the potential to result in hazardous materials releases if the vehicle involved in an accident is hauling hazardous materials. The expected impacts of transportation accidents are amplified by the fact that there is often little warning of accidents.

In addition, there are several other important components to the County transportation infrastructure, as shown in Figure 3.3.16-2. These include an airport and a railroad line. Accidents involved aircrafts or railroads could also have significant impacts on Charles County. Additionally, aircrafts traveling to nearby airports shown in Figure 3.3.16-3 could cause significant damage to structures, populations, infrastructure, and the environment if one were to crash in Charles County.

Figure 3.3.16-1:Charles County Average Annual Daily Traffic Volumes

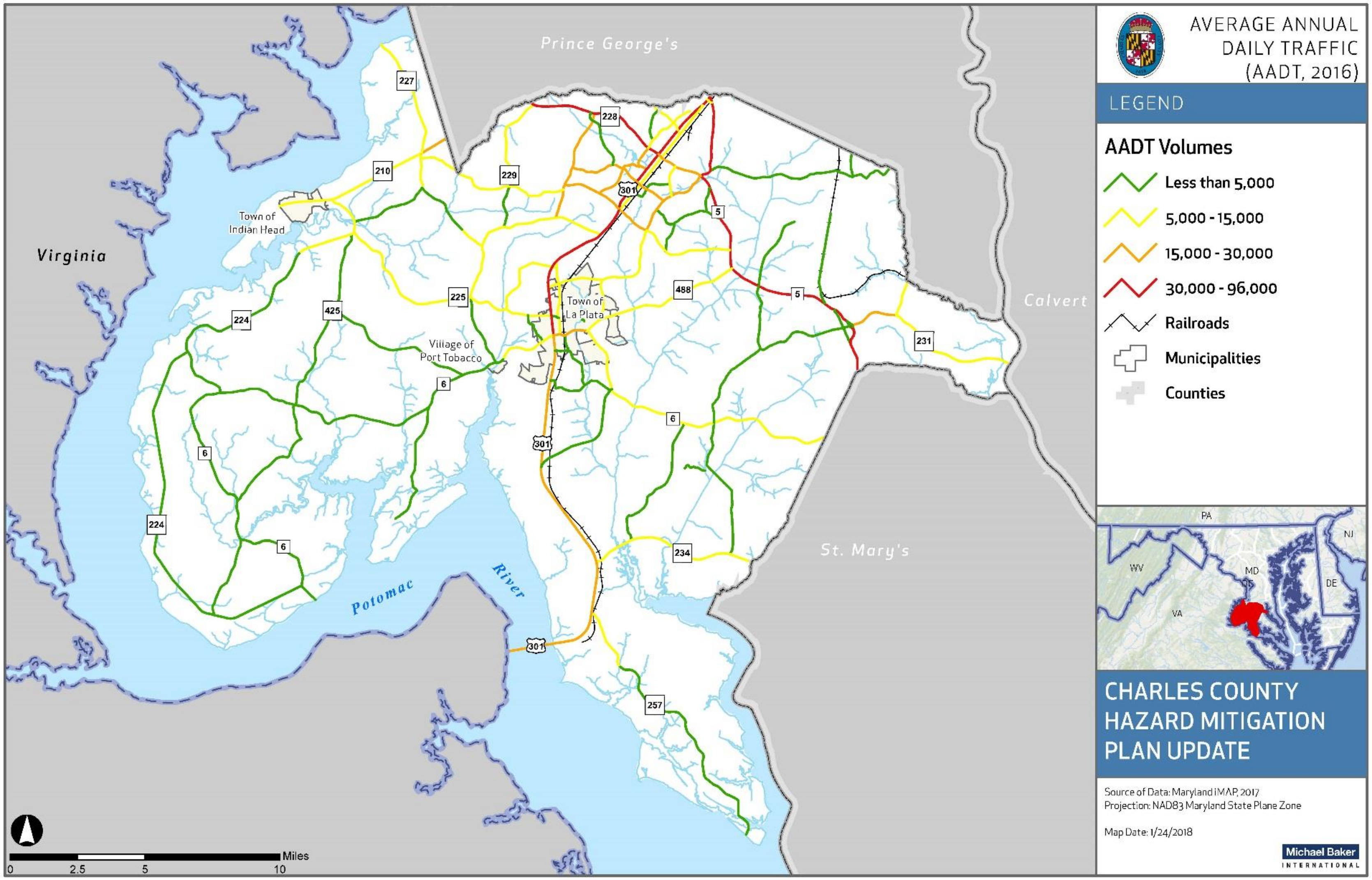


Figure 3.3.16-2:Charles County Airport Locations, Highways, and Railroads

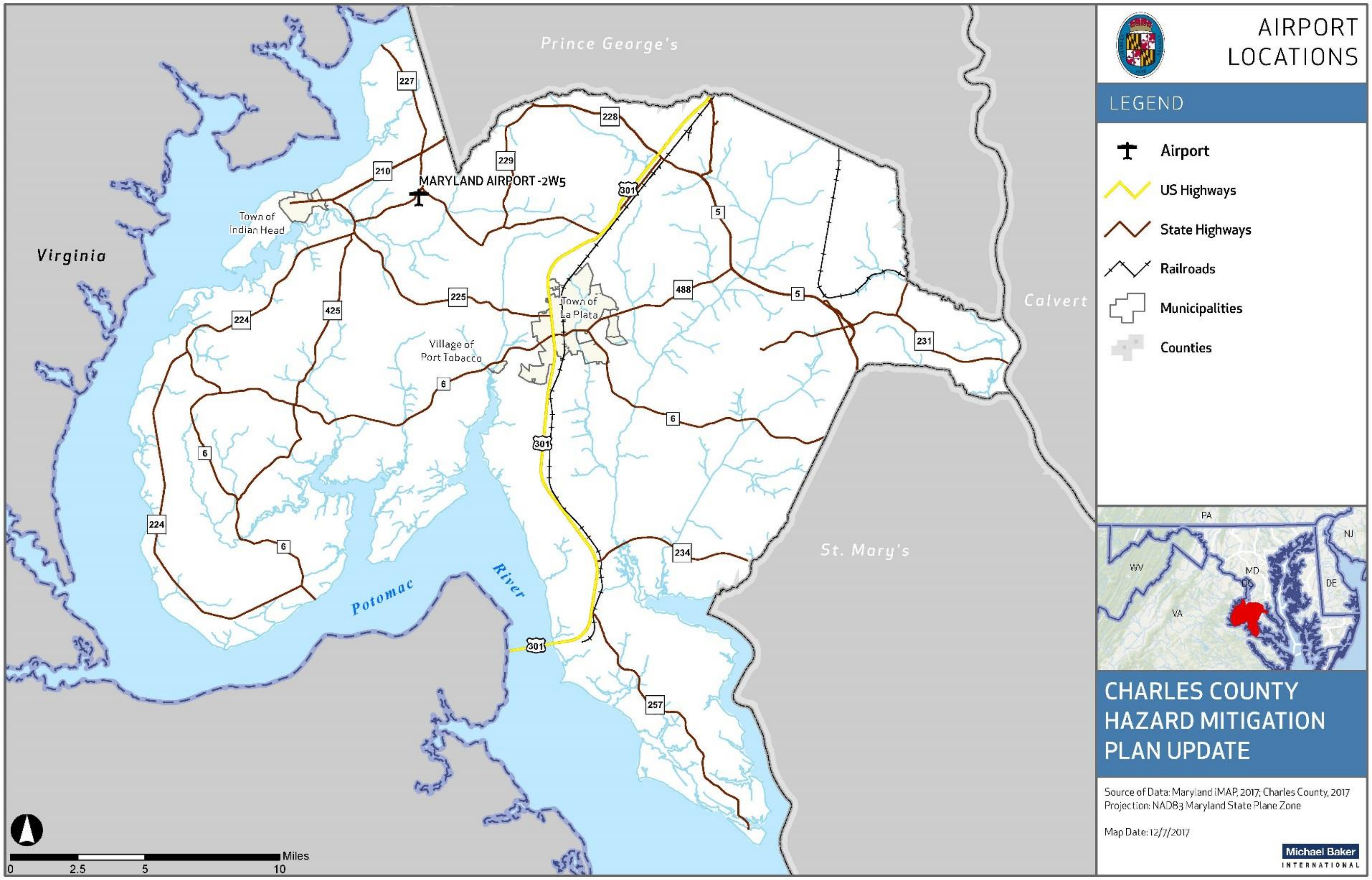
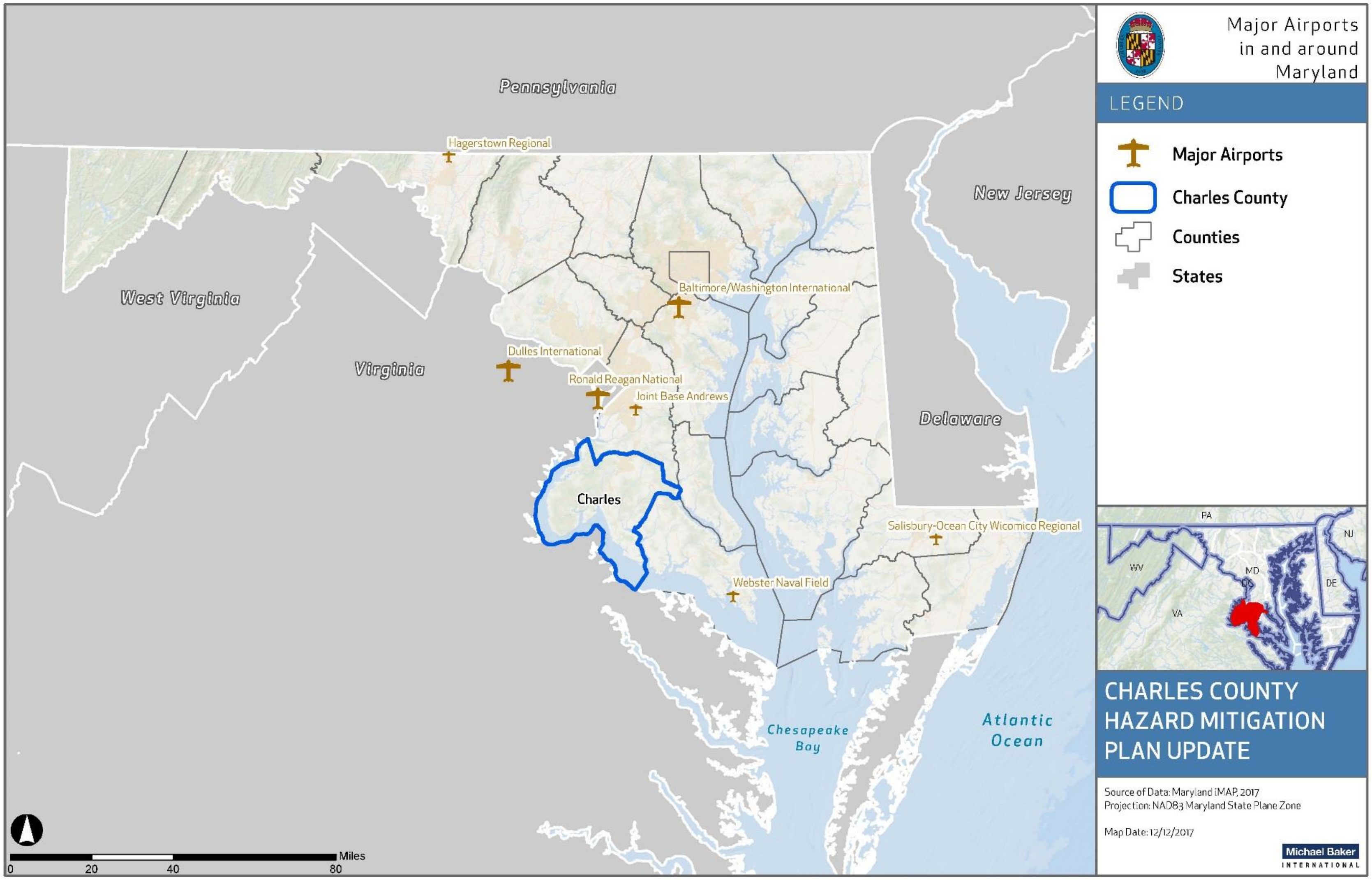


Figure 3.3.16-3: Major Airports in and around Maryland



The worst-case scenario for a transportation accident impacting Charles County would be a road accident which results in a hazardous material spill leading to immediate health hazard, or an accident involving an aircraft crash landing in a populated section of the County.

3.3.16.2 Past Occurrence

The most common transportation accidents in Charles County are highway accidents involving motor vehicles. The County's most serious road transportation concerns involve the U.S. Highway 301, State Highway 228, and State Highway 5 since these routes have the highest annual average traffic counts in the County. Additionally, there is a temporal aspect to highway transportation accidents; in the spring and early summer, when construction and narrowed lanes are commonplace, the incidence of large-scale transportation accidents increases. On a smaller time frame, rush hour periods will see much higher volume of traffic than other times of the day depending on the location.

Maryland Department of Transportation statistics for reportable vehicle accidents in Charles County from 2012 to 2016 are shown in Table 3.3.16-1. This was the most current data available during the HMP update process. There has been a notable rise in the total number of crashes and the number of crashes that have resulted in injury in 2015 and 2016. In 2016, there was nearly double the number of accidents that resulted in at least one death than the year before.

Table 3.3.16-1: Charles County Vehicle Crash Statistics 2012-2016 (MDOT, 2016)

YEAR	TOTAL CRASHES	TOTAL CRASHES THAT RESULTED IN INJURY	TOTAL CRASHES THAT RESULTED IN DEATH
2012	2,336	820	14
2013	2,396	826	14
2014	2,481	815	7
2015	2,637	868	14
2016	2,974	960	26
Total	**12,824**	**4,289**	**75**

There are no recorded past occurrences accidents involving rail or air traffic that have impacted Charles County.

3.3.16.3 Future Occurrence

Charles County's population has grown by over 5% from 2010 to 2016, which suggests that traffic volumes have risen accordingly. New residents have limited knowledge of detour routes and alternate routes around accidents, contributing to the possibility of accident-related congestion. The continued or elevated numbers of tractor-trailers on the County's road system could also contribute to incidences of transportation accidents. While air and rail-related transportation accidents are not as likely to impact the County because of their lower frequency, it is possible that highway accidents may increase slightly without proper mitigation strategies in place.

Overall, the probability of future transportation accidents in Charles County can be considered *highly likely* (4 out of 4) according to the Risk Factor Methodology.

3.3.16.4 Vulnerability Assessment

A transportation-related incident can occur on any stretch of roadway in Charles County. However, severe accidents are more likely to occur on the County's highways, which experience heavier traffic volumes including heavy freight vehicles. The combination of high traffic volume, occasional severe winter weather, and large numbers of hazardous materials haulers increase the chances of traffic accidents occurring.

Because of the widespread transportation network in Charles County, a large number of structures are exposed to the threat of transportation accidents. Table 3.3.16-3 shows the structures in transportation accident hazard zones for highways, rail lines, and airport in Charles County. Table 3.3.16-4 shows the number of critical facilities within these hazard areas.

3.3.16.5 Jurisdictional Differences

As shown in the tables below, the unincorporated areas of Charles County and the Town of La Plata are most vulnerable to the impacts of transportation accidents on major highways. There are 2,374 structures in the unincorporated areas of Charles County located within 0.25 miles of a major highway and 79 critical facilities within these areas, while there are 693 structures and 19 critical facilities in La Plata near major highways. Both the Town of La Plata and the unincorporated areas of the County are also at the greatest risk of being impacted by an accident involving an active rail line. Additionally, there are over 7,000 structures and 90 critical facilities within five miles of an airport in the unincorporated portions of the County, and there are 157 structures in Indian Head near airports, making these jurisdictions at a higher risk to aircraft-related incidents. The Village of Port Tobacco is at the lowest risk to all types of transportation accidents, with zero structures or critical facilities near major highways, active rail lines, or airports.

Table 3.3.16-1: Structures Vulnerable to Transportation Accidents in Charles County

MUNICIAPLITY	TOTAL STRUCTURES	TOTAL STRUCTURES WITHIN 0.25 MILES OF MAJOR HIGHWAY	PERCENT STRUCTURES WITHIN 0.25 MILES OF MAJOR HIGHWAY	TOTAL STRUCTURES WITHIN 0.25 MILES OF ACTIVE RAIL LINE	PERCENT STRUCTURES WITHIN 0.25 MILES OF ACTIVE RAIL LINE	TOTAL STRUCTURES WITHIN 5 MILES OF AIRPORT	PERCENT STRUCTURES WITHIN 5 MILES OF AIRPORT
Charles County Unincorporated Areas	61,656	2,374	3.85%	2,619	4.25%	7,720	12.52%
Town of Indian Head	1,680	0	0.00%	0	0.00%	157	9.35%
Town of La Plata	4,126	693	16.80%	1,124	27.24%	0	0.00%
Village of Port Tobacco	11	0	0.00%	0	0.00%	0	0.00%
Total	**67,473**	**3,067**	**4.55%**	**3,743**	**5.55%**	**7,877**	**11.67%**

Table 3.3.16-2: Critical Facilities Vulnerable to Transportation Accidents in Charles County

MUNICIAPLITY	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES WITHIN 0.25 MILES OF MAJOR HIGHWAY	PERCENT CRITICAL FACILITIES WITHIN 0.25 MILES OF MAJOR HIGHWAY	CRITICAL FACILITIES WITHIN 0.25 MILES OF ACTIVE RAIL LINE	PERCENT CRITICAL FACILITIES WITHIN 0.25 MILES OF ACTIVE RAIL LINE	CRITICAL FACILITIES WITHIN 5 MILES OF AIRPORT	PERCENT CRITICAL FACILITIES WITHIN 5 MILES OF AIRPORT
Charles County Unincorporated Areas	573	79	13.79%	69	12.04%	90	15.71%
Town of Indian Head	23	0	0.00%	0	0.00%	0	0.00%
Town of La Plata	82	19	23.17%	27	32.93%	0	0.00%
Village of Port Tobacco	0	0	0.00%	0	0.00%	0	0.00%
Total	**678**	**98**	**14.45%**	**96**	**14.16%**	**90**	**13.27%**

3.3.16.6 Land Use and Development Trends

As population grows in Charles County, as will the transportation needs of the community. Therefore, maintaining and enhancing transportation infrastructure will be necessary to meet the demand. Already, some roads in the northern part of the County are heavily trafficked, and will be at greater risk for experiencing accidents as the population grows. Similarly, as population grows, the number of housing units and other structures near major highways, active rail lines, and the airport will likely also rise and therefore increase vulnerability.

3.3.17 Utility Interruption

HAZARD TYPE	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING
Human-Made	4	1	2	3	2	**2.4**
MODERATE RISK (2.0 – 2.9)						

3.3.17.1 Location, Extent, and Range of Magnitude

Utility interruptions in Charles County focus primarily on power failures, which are often a secondary impact of another hazard event. For example, severe thunderstorms or winter storms could bring down power lines and cause widespread disruptions in electricity service. Strong heat waves may also result in rolling blackouts where power may not be available for an extended period of time. Additionally, local outages may be caused by traffic accidents or wind damage. Utility interruptions and power failures can take place throughout the entirety of Charles County.

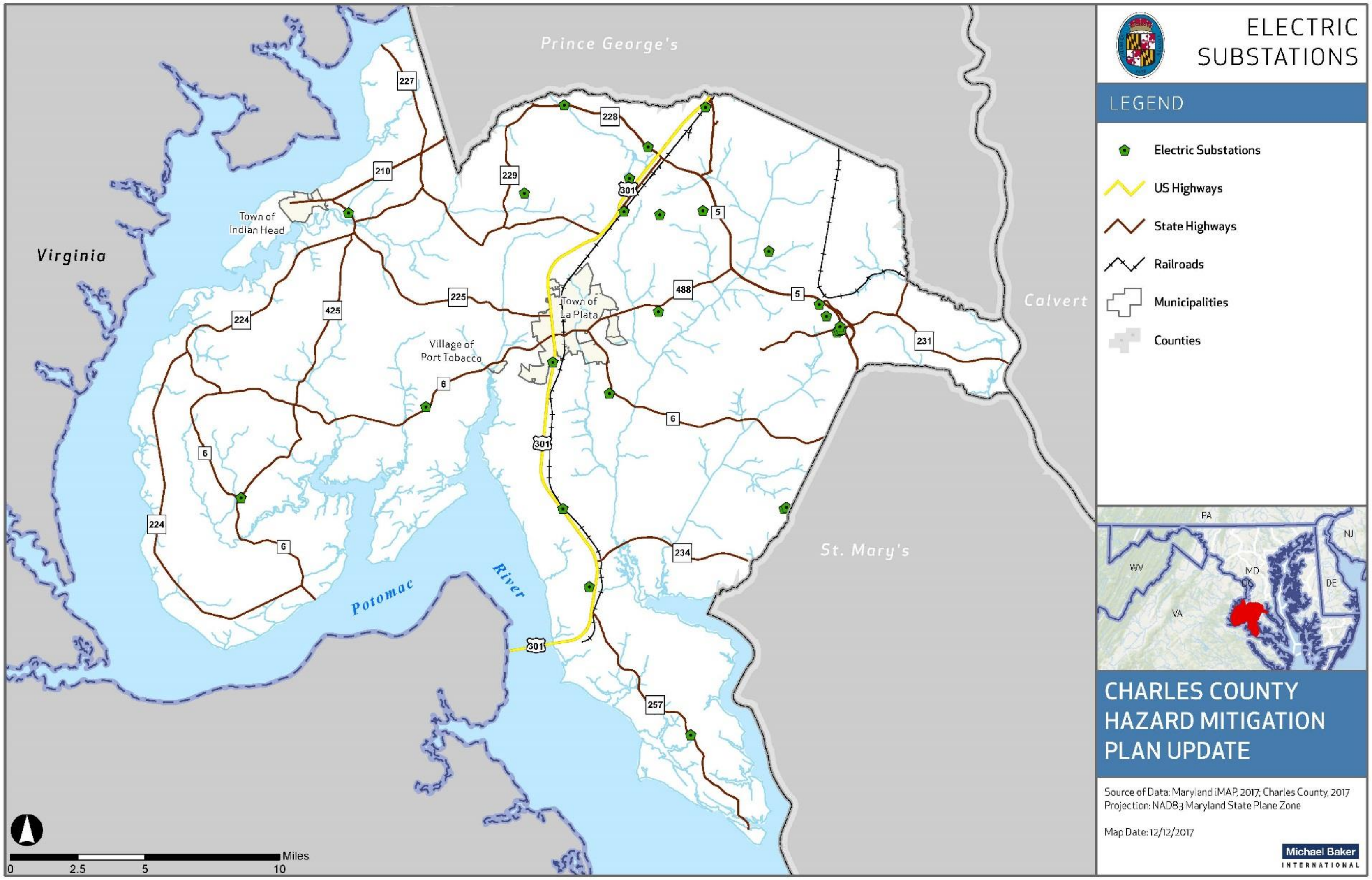
Most severe power failures or outages are regional events. With the loss of power, electrical-powered equipment and systems will not be operational. Examples may include:

- Lighting
- HVAC and ancillary support equipment
- Communication systems (public address systems, telephone, computer servers, and peripherals)
- Ventilation systems
- Fire and security systems
- Refrigerators
- Sterilizers
- Trash compactors
- Office equipment
- Medical equipment

This can cause food spoilage, loss of heat or air conditioning, basement flooding (sump pump failure), lack of light, loss of water (well pump failure), lack of phone service, or lack of internet service. However, this is most often a short-term nuisance rather than a catastrophic hazard. At a minimum, power outages can cause short term disruption in the orderly functioning of business, government, and private citizen functioning and activities. A worst-case scenario for utility interruption in Charles County would involve a power outage during the winter snow or ice storm. Downed trees and wires from the heavy ice formation could cause power outages throughout the entirety of the County for prolonged periods of time.

Figure 3.3.17-1 depicts the location of electric substations in Charles County. If any of these facilities were damaged or impacted by a hazard event, there would be the potential for widespread power outages throughout the County.

Figure 3.3.17-1: Electric Substations in Charles County



3.3.17.2 Past Occurrence

Utility interruptions are largely minor, routine events. In Charles County, minor power outages occur several times per year. They are most often associated with winter storms and thunderstorms with high winds. There is currently no complete or comprehensive inventory of past occurrences of utility interruptions for the County; however, the HMPC indicated that there was a large network outage in 2016 that disruption 60% of services.

3.3.17.3 Future Occurrence

Minor power failure (i.e. short outage events) may occur several times a year for any given area in Charles County, while major (i.e. widespread, long outage) events take place once every few years. Power failures are often occurrences during severe weather and therefore, should be expected during those events. Therefore, the future occurrence of utility interruptions in Charles County can be considered *highly likely* (4 out of 4) as defined by the Risk Factor methodology probability criteria. These interruptions should be anticipated and first responders should be prepared during severe weather events.

3.3.17.4 Vulnerability Assessment

Emergency medical facilities, including retirement homes and senior centers are particularly vulnerable to power outages. While back-up power generators are often used at these facilities, loss of electricity may result in hot or cold temperatures for which elderly populations are particularly vulnerable. There are currently 71 nursing home and long-term care facilities in Charles County, and Appendix E provides details about these facilities and their locations. Conservation and improved technology have resulted in more efficient use of energy sources. The increasing use of alternative fuel supplies, such as kerosene heaters, wood burning stoves, and coal burners, has also decreased our vulnerability to future shortages. However, extreme weather events, transportation accidents, or nationwide shortages could cause significant energy shortage problems. Vulnerability may also depend on the utility provider.

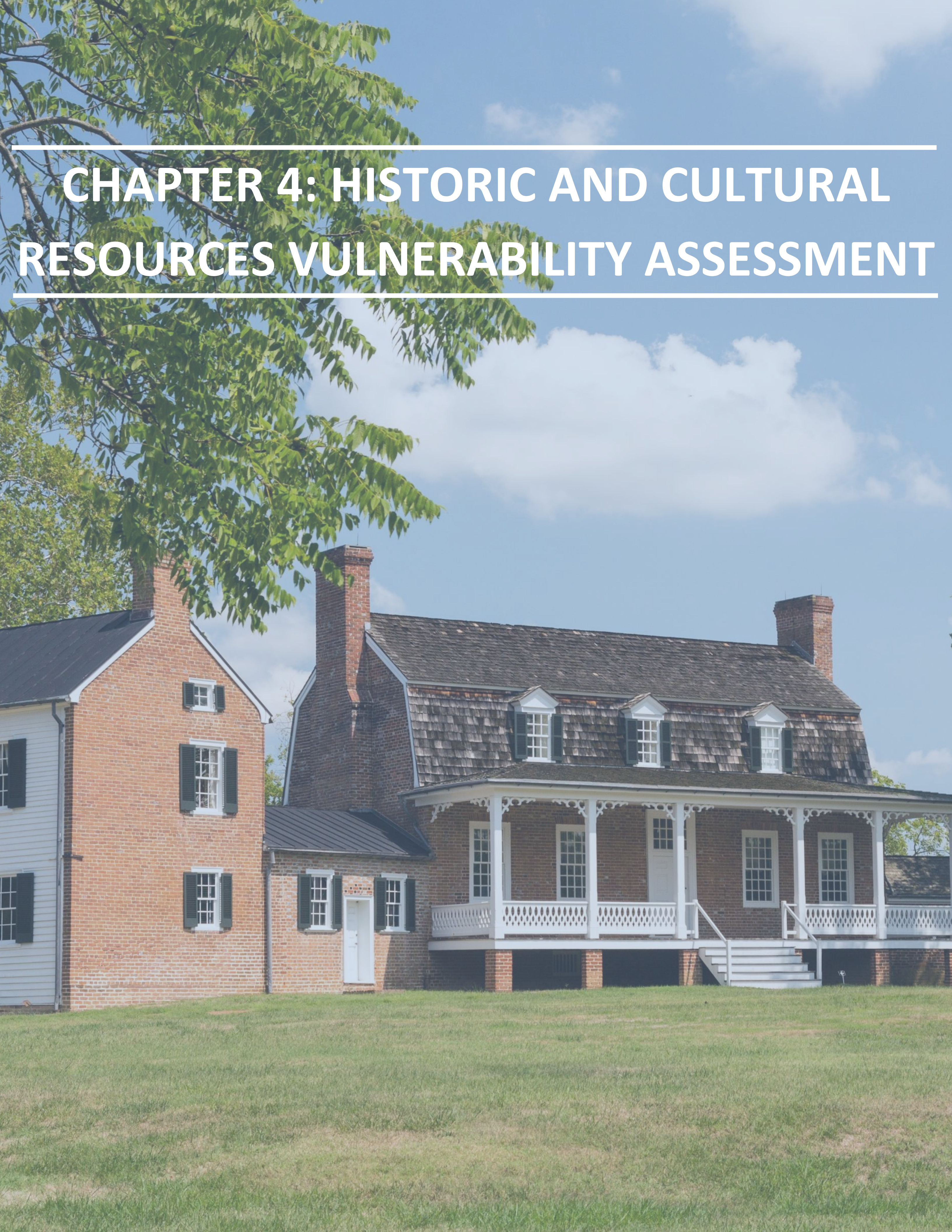
3.3.17.5 Jurisdictional Differences

Due the unpredictable and often regional nature of utility interruptions, all jurisdictions in Charles County are considered to be at equal risk.

3.3.17.6 Land Use and Development Trends

All future structures and infrastructure built in Charles County will likely be exposed to the impacts of utility interruption. As a result, the location of development does not increase or reduce the risk necessarily. However, if utility lines are upgraded or buried in certain areas of the County, such as in areas with concentrations of new development, these areas could potentially be at a lower risk to experiencing power outages as a result of downed power lines.

CHAPTER 4: HISTORIC AND CULTURAL RESOURCES VULNERABILITY ASSESSMENT



4 Historic and Cultural Resources Vulnerability Assessment

4.1 Overview

Historic resources include landmark buildings, historic structures and sites, commercial and residential districts, historic rural resources, archaeological and cultural sites, and the historic environment in which they exist. Historic resources serve as visual reminders of a community's past, providing a link to its cultural heritage and a better understanding of the people and events that shaped the patterns of its development. Preservation of these important resources makes it possible for them to continue to play an integral, vital role in the community. Disaster events can have significant impacts on all life and property; however, the impacts can be particularly devastating on historic and cultural resources because many are irreplaceable. Therefore, it is essential to consider these resources in the mitigation planning process.

Currently Charles County contains 41 entries on the National Register of Historic Places (NRHP), including 31 buildings, five districts, two sites, two buildings/sites, and one object. The County also contains one National Historic Landmark, which is The Thomas Stone National Historic Site, also known as Habre de Venture or Thomas Stone House, located on Rose Hill Road between MD 6 and MD 225 in Port Tobacco. This site is shown in Figure 4.1.1-1. Charles County also contains 1,006 sites on the Maryland Inventory of Historic Properties (MIHP), 112 of which are potentially eligible for inclusion on the NRHP. There are also currently 939 recorded archaeological sites in the County, although there are likely more sites that have not yet been found. Like other valuable assets and critical facilities throughout the County, these historic and cultural resources are essential to protect, preserve, and consider when assessing risk and vulnerability.

Figure 4.1.1-1: Thomas Stone National Historic Site located in Port Tobacco

Charles County initially was defined as being a rural county. The County has continued to grow over the past twenty years as one of Washington, D.C.'s major bedroom communities. Charles County's growth rate can be attributed to a number of factors including its proximity to the Washington metropolitan area. Charles County's relatively low tax rate, lower housing costs and rural character add to its appeal as a popular market. Population growth has a direct correlation with the loss of historic properties. The 1990 Census reported 1,828 structures built between 1940 and 1949 and 1,930 structures built by 1939 or earlier. These numbers were significantly reduced according to Census 2000 which recorded 1,511 structures built between 1940 and 1949 and 1,701 built by 1939 or earlier, representing a loss of 546 structures. This is roughly equivalent to one historic structure lost per week.

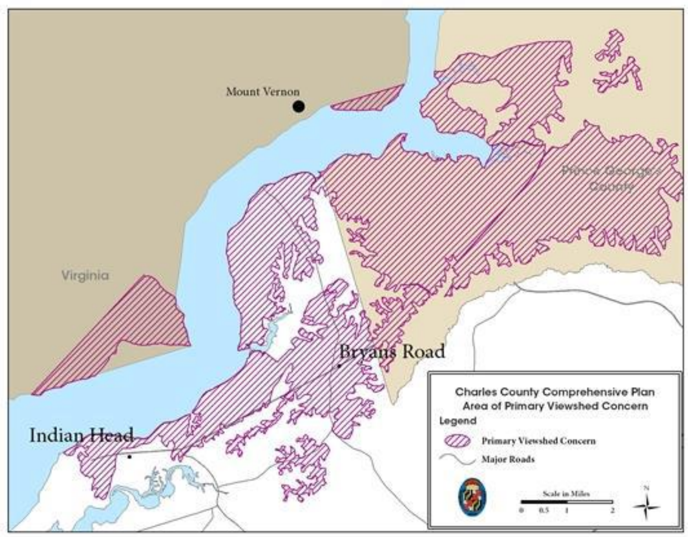
This number continued to decrease and in 2016, there were only 1,505 structures built between 1940 and 1949 and 1,551 built before 1939, indicating that an additional 156 historic structures were lost during this time period (U.S. Census, 2016). Since 1990, recent trends in the County's land use planning have begun to focus population growth and development within a designated growth area. These efforts may indirectly help to protect historic resources located outside designated growth areas. In addition, the County has committed to integrate historic preservation planning into its development review process in order to mitigate the negative impacts of development on historic and archaeological sites.

Depending on the number of historic resources within a community, it is unrealistic to assume that all of the necessary mitigation activities can be done at once to protect these resources. The work must be done in a manner that retains the character-defining features of a historic property, and can be costly. Therefore, it makes sense to set priorities in terms of which resources and mitigation projects should be the point of focus.

Charles County recognizes that the preservation and maintenance of archaeological sites and historic structures contribute to the cultural heritage of the County and are in the long-term best interest of the County. Areas of concern are:

- Architecture
- Archaeology
- Cemeteries
- Cultural Landscapes
- Living Traditions and Folklore
- History Museums and Collections
- Mount Vernon Viewshed

Figure 4.1.1-2: Mount Vernon Viewshed (Charles County, 2016)



The Mount Vernon Viewshed, which encompasses portions of Bryans Road, Marshall Hall and Piscataway Park, has been identified as an area concern because future land development and loss of tree cover could potentially have adverse impacts on this historic landscape. Therefore, the County is undertaking measures, such as creating an overlay zone, to protect the view from Mount Vernon as George Washington would have seen it when he lived there. The viewshed is also referenced in the Charles County Comprehensive Plan, and the plan includes a goal in the community development chapter to "protect significant views and vistas from the adverse effects of development including the Mount Vernon Viewshed." The greatest threat to the viewshed is the loss of tree cover, which could happen as a result of erosion, wildfire, tornados, or other natural disaster. Erosion along the shoreline is currently occurring but will likely get worse and could greatly impact the view from Mount Vernon.

The chapter aims to integrate historic preservation planning considerations into the hazard mitigation planning process by:

- Evaluating existing resources and data and identifying gaps.
- Determining which historic properties and cultural resources are vulnerable to hazard events.
- Prioritizing historic and cultural resources for mitigation action.

Some historic and cultural resources also have unique vulnerabilities to hazard events. Depending on the resource, vulnerability to certain hazards may be greater and/or less than that of other assets in the County. For example, historic paper documents may not be impacted by an earthquake or severe winter storms, but historic properties have the potential to be more significantly impacted by these events than newer structures constructed to comply with modern building codes and development regulations. Similarly, flooding may have a more significant impact on a historic property than other properties, but there may be less of an impact on historic sites such as monuments or cemeteries.

4.2 Data Sources and Gap Analysis

The first step of assessing the vulnerability of historic and cultural resources in Charles County involved collecting existing data and resources and conducting a gap analysis. The following datasets were used to conduct this analysis and develop this chapter:

- **National Register of Historic Places (NRHP):** The NRHP is National Park Service's list of the Nation's historic places worthy of preservation. It includes districts, sites, buildings, structures, and objectives significant to American historic, architecture, archaeology, engineering, and culture. There are over 90,000 sites on the list throughout the United States, more than 1,500 of which are located in the State of Maryland. Charles County contains 41 listings on the National Register of Historic Places. This data was available in GIS format, which allowed the County to assess vulnerability of these sites to hazard events. Information about individual NRHP sites can be viewed on NRHP database on the National Park Service's website. Photographs and registration forms for each site can be viewed and downloaded. Registration forms include a description of each site as well as information about a site's location, classification, function or use, and significance.
- **Maryland Inventory of Historic Properties (MIHP):** An inventory created by the Maryland Historical Trust (MHT) which contains historic districts, sites, buildings, structures, and objects of known or potential value to the history of the State of Maryland. The inventory contains data on over 13,000 archaeological sites and 43,000 historic and architectural resources. 1,006 historic and cultural resources are located in Charles County and were evaluated in this plan; however, information about archaeological sites was not available for incorporation into this HMP Update due to the sensitivity of the information. This data was also available in GIS format. MHT maintains a similar searchable database for properties listed on the MIHP, although the level of information available for each site varies. For example, some include the MHT MIHP Properties Form, which includes information about the property, its location, classification, and significance, while others include NRHP nomination forms. Additionally, some files contain extensive photos of the

property, while others do not contain any. Some entries only include brief descriptions of the site and a map depicting its location.

- **Historic Preservation Easements:** This dataset includes properties where owners have entered into an easement agreement with MHT to protect the historic character of their property. There are 17 of these easements in Charles County. This data was also available in GIS format.
- **County Cemetery Inventory:** Charles County maintains list of cemeteries in the County and their property owners. This dataset contained 135 sites, 65 of which contain GPS coordinates. During the HMP Update, coordinates were obtained for an additional 16 sites, which allowed 81 of the cemeteries to be analyzed for their vulnerability to hazard events.
- **Recommended National Register Eligible Resources (RNRE):** Charles County maintains a list of sites that are recommended for inclusion on the NRHP. RNRE resources listed in this HMP have been evaluated by Charles County Department of Planning and Growth Management staff and are considered likely to meet NRHP criteria and/or are locally significant. However, these resources have not been formally evaluated or determined eligible for the NRHP by the Maryland Historical Trust. This list contains 112 sites that are currently on the MIHP. These sites were assessed with the MIHP properties, but these 112 sites are highlighted in the following analysis.

Resources identified in the NRHP, MIHP, and the Historic Preservation Easements dataset are shown in Figure 4.2-1 and the 81 cemeteries for which GPS coordinates were available are shown in Figure 4.2-2.

The NRHP and MIHP provided the most valuable information about historic properties in Charles County for the vulnerability analysis. Coupled with the list of MIHP sites that are potentially eligible for the NRHP, these data sources helped provide a means to prioritize sites based on their historical significance. However, there remain gaps in data availability. The following recommendations were developed based on this analysis:

- Identify additional information about cemeteries throughout Charles County and obtain location information for the remaining 54 sites.
- Identify which cemeteries are adjacent to or associated with structures on either the NRHP or MIHP.
- Obtain archaeological site data and surveys from MHT.
- Continue to survey properties for inclusion on the MIHP and evaluate for NRHP eligibility or local significance.
- Utilize predictive models and approaches outlined in the *Indigenous Cultural Landscapes Study for the Nanjemoy and Mattawoman Creek Watersheds* study to identify indigenous cultural landscapes of historic and cultural significance to the County and assess the vulnerability of these landscapes.

To be considered eligible for the National Register of Historic Places, and property generally has to be at least 50 years old. As shown in Table 4.2.1-1, the County contains many properties that were constructed more than 50 years ago. The largest concentrations of these properties are located in Thompkinsville, Pomonkey, Nanjemoy, and Marbury. Charles County should also consider reviewing property records and surveying sites that aren’t currently on the NRHP or MIHP to determine if they could potentially be eligible for either list.

Figure 4.2-1: Historic Resources in Charles County

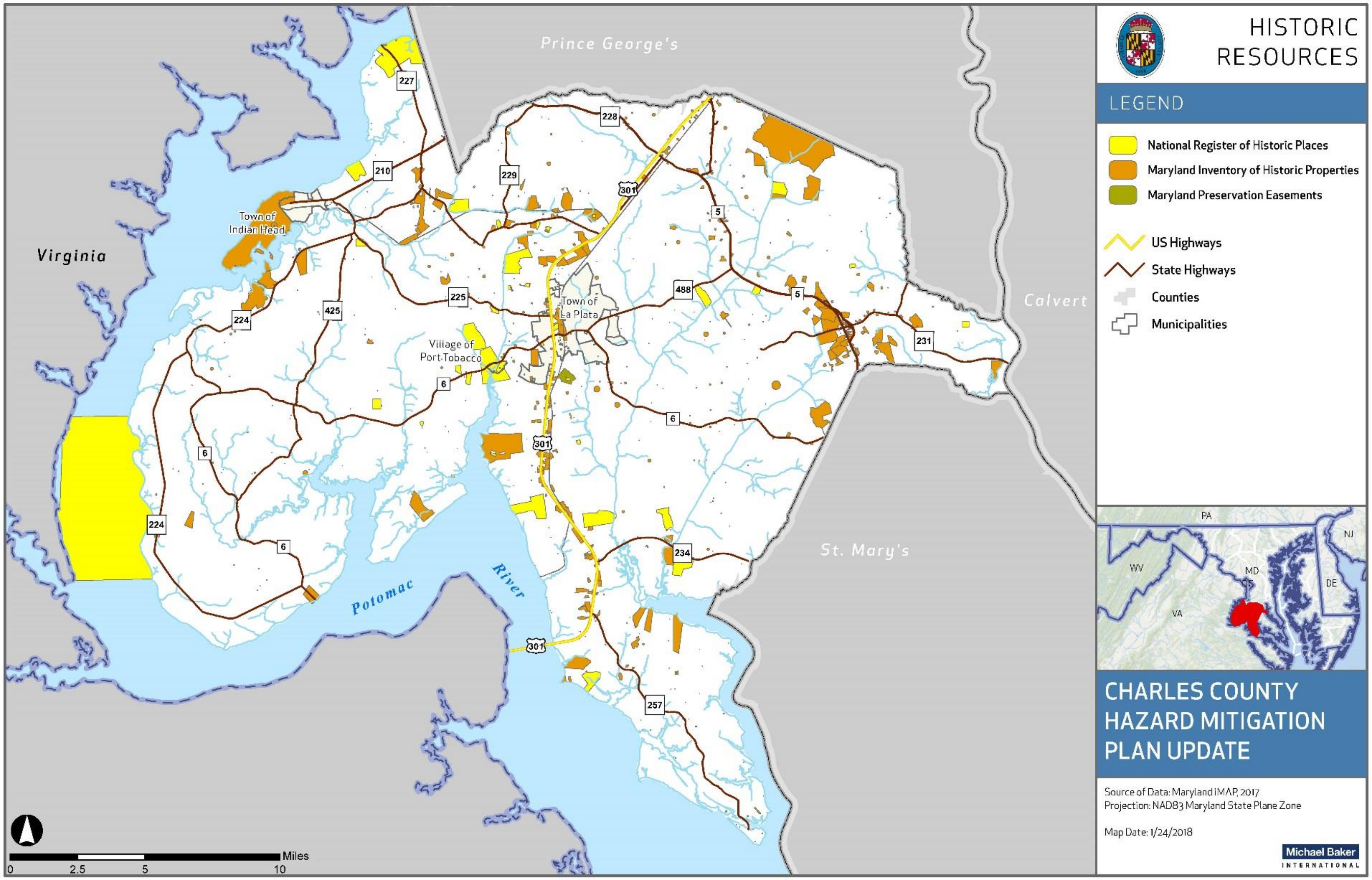


Figure 4.2.1-1: Cemeteries in Charles County

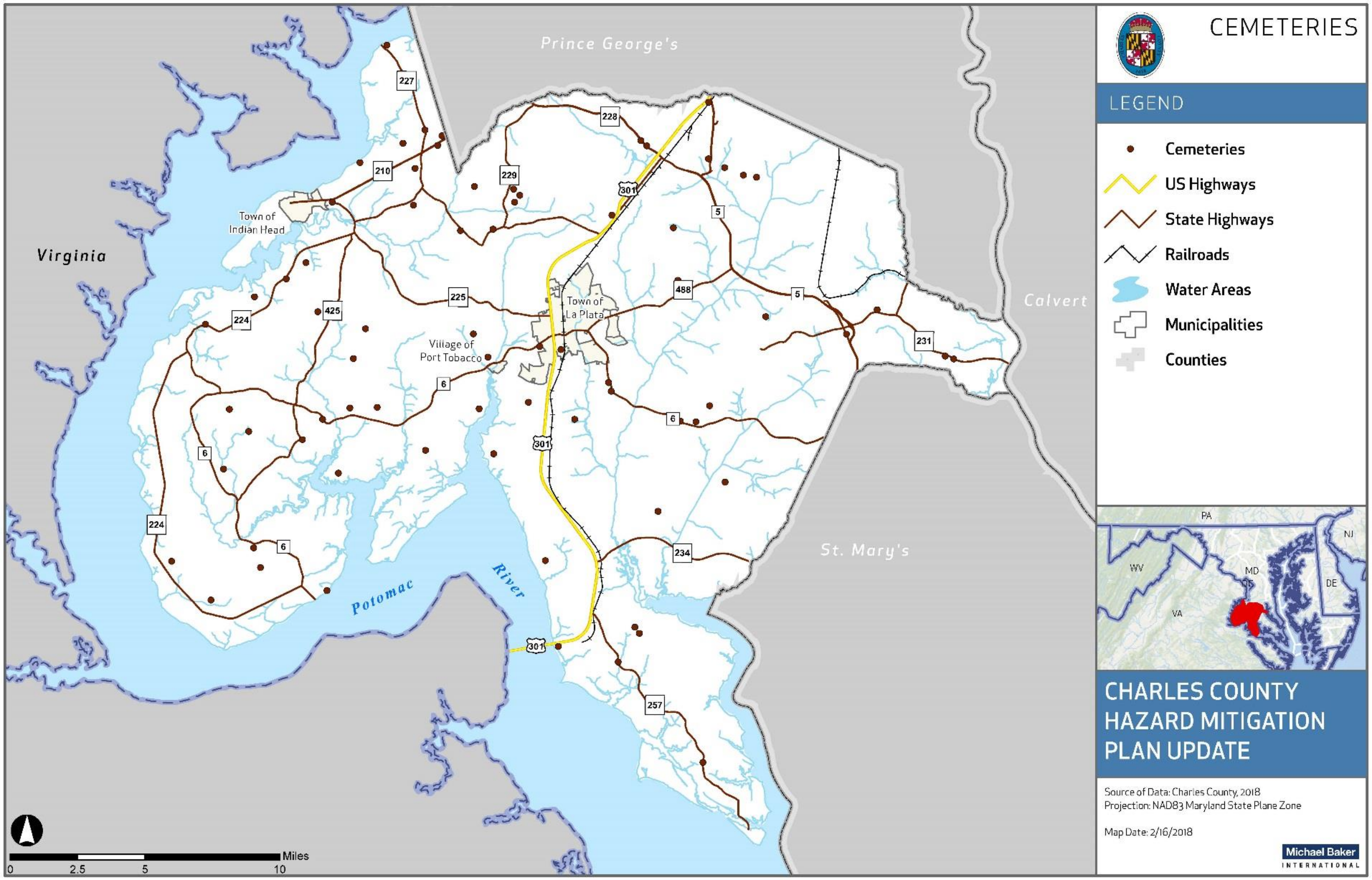


Table 4.2.1-1: Age of Structures by Area of Charles County

YEAR BUILT	LA PLATA	HILL TOP	NANJEMOY	ALLENS FRESH	THOMPKINS VILLE	WALDORF	POMONKEY	BRYANTOWN	HUGHES VILLE	MARBURY
Total Structures	5338	754	1402	2169	2255	31139	5818	5095	2489	1555
Built 1960 to 1969	554	85	177	106	179	2514	981	480	25	156
Built 1950 to 1959	179	48	178	147	369	538	576	167	75	98
Built 1940 to 1949	122	24	140	35	77	339	583	80	17	88
Built 1939 or earlier	157	21	42	8	362	271	323	88	63	216
Total Built Prior to 1969	**1012**	**178**	**537**	**296**	**987**	**3662**	**2463**	**815**	**180**	**558**
% Built Prior to 1969	**18.96%**	**23.61%**	**38.30%**	**13.65%**	**43.77%**	**11.76%**	**42.33%**	**16.00%**	**7.23%**	**35.88%**

4.3 Vulnerability Assessment

The analysis of historical and cultural resource vulnerability focused on natural hazards that have geographically distinct vulnerabilities. For example, all structures, critical facilities, and population in the County are vulnerable to hazards such as severe winter storms, extreme temperatures, and extreme weather; however, the vulnerability of an asset varies significantly for other hazards depending on its geographic location. For example, structures in the SFHA are much more vulnerable to flooding, whereas assets in the WUI are at a higher risk to wildfire. Since all historic and cultural resources can be considered vulnerable to many of the hazards that have regional or county-wide impacts, this analysis focused on assessing vulnerability to the following location-specific hazards to help identify the most at-risk historic and cultural resources in the County:

- Flood
- Erosion
- Earth Disturbance (Landslide)
- Wildfire

4.3.1 Flood Vulnerability

Table 4.3.1-1 displays the number of historic and cultural resources that intersect the Special Flood Hazard Area (SFHA) in each jurisdiction. They are categorized as follows:

- NRHP Sites
- MIHP Sites
- RNRE Sites
- Properties with Historic Preservation Easements

The numbers of vulnerable addressable structures and critical facilities were calculated by overlaying the addressable structures with the SFHA as shown in the FIRM data. Select results of this analysis are also shown for each jurisdiction on the maps in Figures 4.3.1-1 through 4.3.1-3. These maps depict the SFHA as well as NRHP sites, MIHP sites, and properties with historic preservation easements.

As shown in Table 4.3.1-1, 16 NRHP sites (39.02%) are located in the SFHA. A list of these sites is shown in Table 4.3.1-2. While only 9.34% of sites on the MIHP are located in the SFHA, this amounts to 94 sites of historic importance. Additionally, six of those sites are potentially eligible for the NRHP. Zero of 17 properties with historic preservation easements were located in the SFHA. While not shown in the table, there were no cemeteries located in the SFHA.

The vast majority of historic sites vulnerable to flooding are located in the unincorporated areas of Charles County, while several historic sites or districts in the SFHA are located in the Village of Port Tobacco. None of the historic sites in La Plata are in the SFHA, and the Town of Indian Head does not contain any historic sites on the lists mentioned above within its municipal boundaries, although several historic sites associated with the Naval Ordnance Station are located nearby.

Table 4.3.1-1: Historic and Cultural Resource Flood Vulnerability

MUNICIPALITY	TOTAL NRHP SITES	TOTAL NRHP SITES IN SFHA	PERCENT NRHP SITES IN SFHA	TOTAL MIHP SITES	TOTAL MIHP SITES IN SFHA	PERCENT MIHP SITES IN SFHA	TOTAL RNRE SITES	TOTAL RNRE SITES IN SFHA	PERCENT RNRE SITES IN SFHA	TOTAL HISTORIC PRES. EASEMENTS	TOTAL HISTORIC PRES. EASEMENTS IN SFHA	PERCENT HISTORIC PRES. EASEMENTS IN SFHA
Charles County Unincorporated Areas	37	15	40.54%	886	90	10.16%	101	6	5.94%	14	0	0.00%
Town of Indian Head	0	0	0.00%	0	0	0.00%	0	0	0.00%	0	0	0.00%
Town of La Plata	2	0	0.00%	68	0	0.00%	10	0	0.00%	0	0	0.00%
Village of Port Tobacco	2	1	50.00%	52	4	7.69%	1	0	0.00%	3	0	0.00%
Total	**41**	**16**	**39.02%**	**1,006**	**94**	**9.34%**	**112**	**6**	**5.36%**	**17**	**0**	**0.00%**

Figure 4.3.1-1: Historic and Cultural Resource Flood Vulnerability in the Town of La Plata

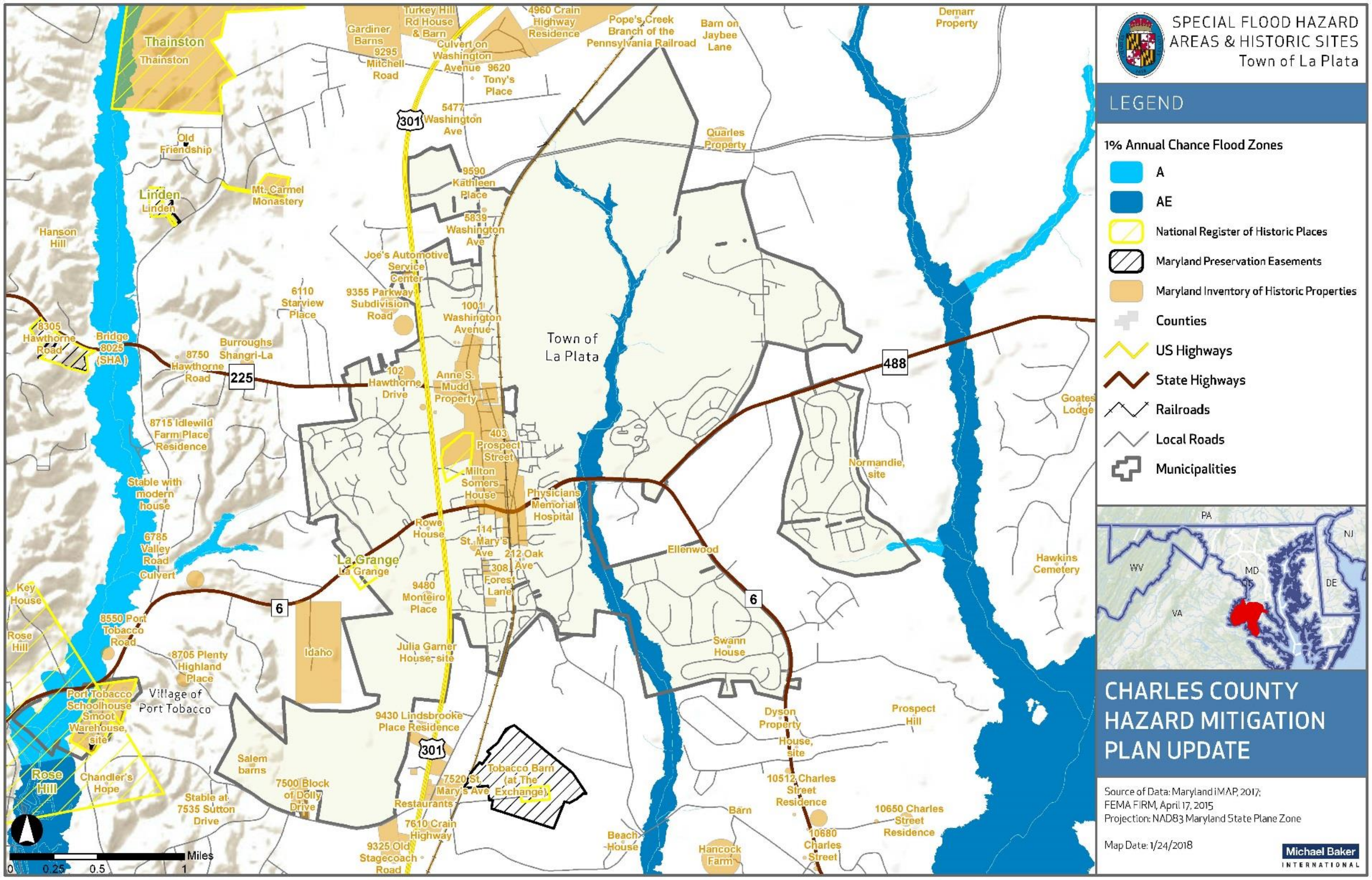


Figure 4.3.1-2: Historic and Cultural Resource Flood Vulnerability in the Town of Indian Head

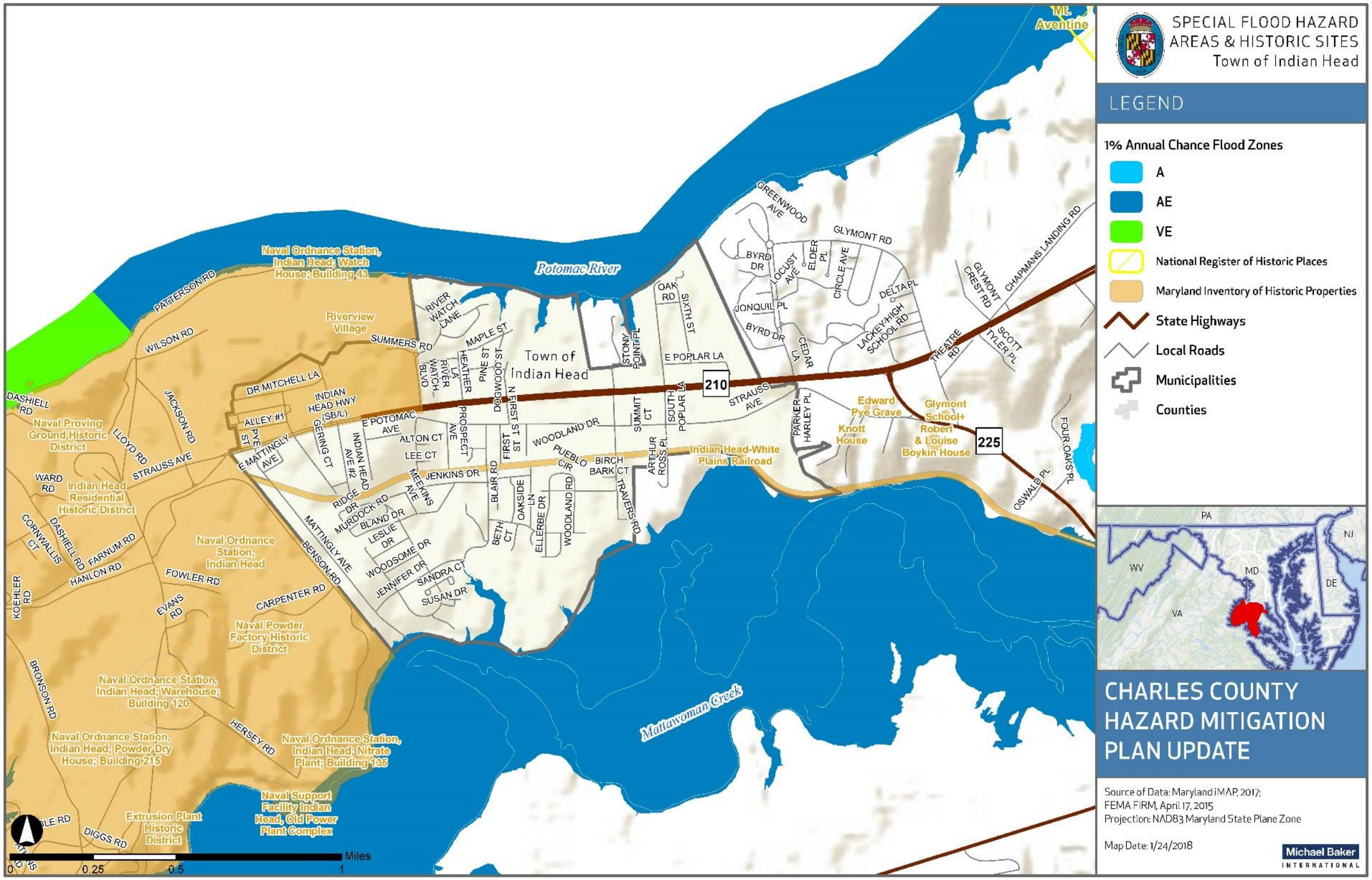


Figure 4.3.1-3: Historic and Cultural Resource Flood Vulnerability in the Town of Port Tobacco Village

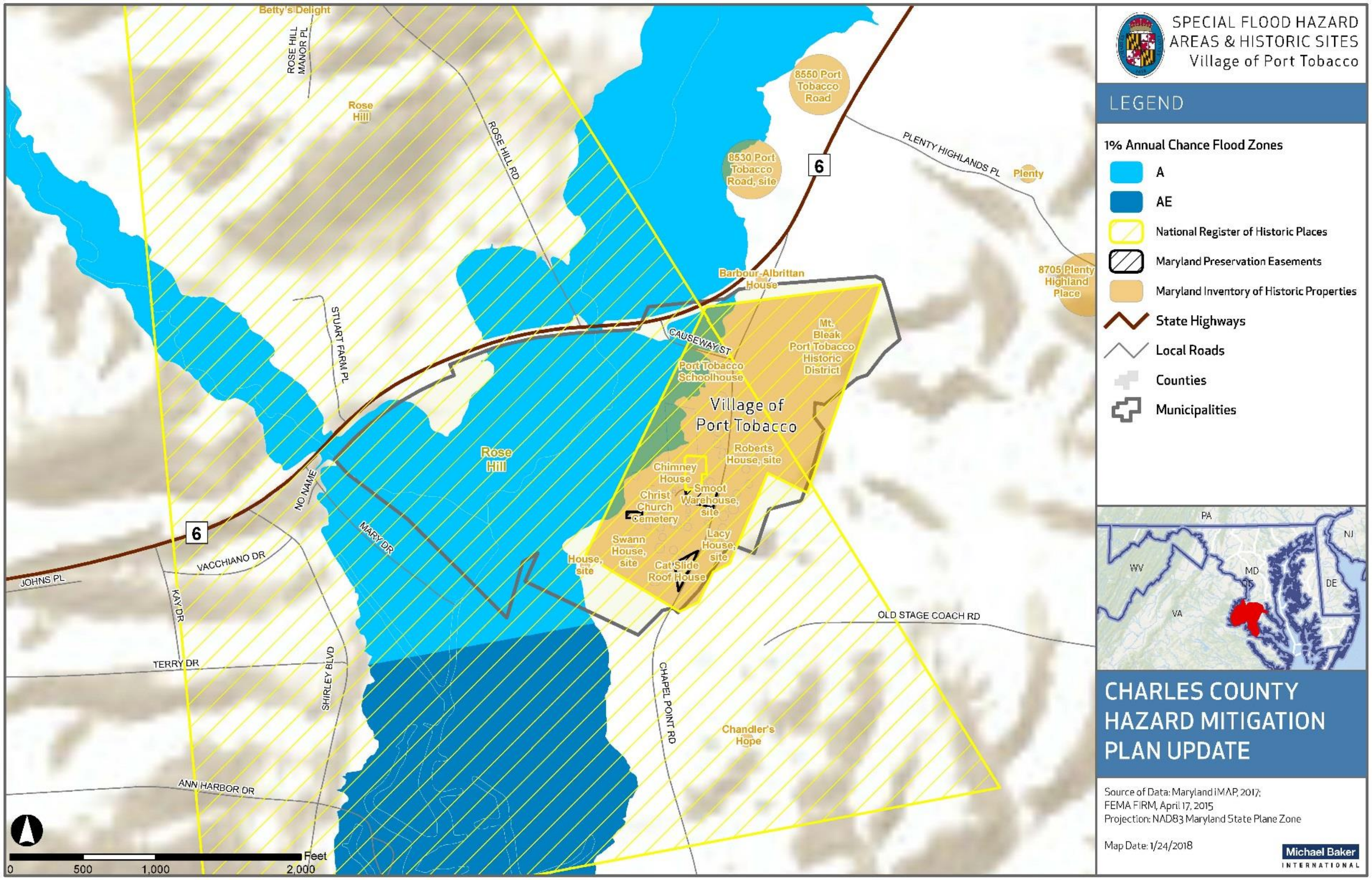


Table 4.3.1-2: NRHP Sites Located in the SFHA

NAME	TYPE	JURISDICTION
McPherson's Purchase	Building	Charles County Unincorporated Areas
Mount Air	Building	Charles County Unincorporated Areas
Rose Hill	Building	Charles County Unincorporated Areas
Sarum	Building	Charles County Unincorporated Areas
St. Catharine	Building	Charles County Unincorporated Areas
The Lindens	Building	Charles County Unincorporated Areas
Waverley	Building	Charles County Unincorporated Areas
Habre de Venture	Building, Site	Charles County Unincorporated Areas
Timber Neck	Building, Site	Charles County Unincorporated Areas
Bryantown Historic District	District	Charles County Unincorporated Areas
Mallows Bay-Widewater Historic and Archaeological District	District	Charles County Unincorporated Areas
Mt. Aventine	District	Charles County Unincorporated Areas
Port Tobacco Historic District	District	Village of Port Tobacco
Thainston	District	Charles County Unincorporated Areas
Mary W. Somers (Skipjack)	Object	Charles County Unincorporated Areas
Piscataway Park	Site	Charles County Unincorporated Areas
Please note that a district may contain multiple resources, not just one building. Additionally, individual building listings may contain multiple resources. As a result, there may be several buildings or resources included in an individual listing.		

All five historic districts listed on the NRHP in Charles County intersect the SFHA; however, districts are geographically larger than any sites or buildings, and the presence of a SFHA in a historic district may not pose a significant threat to people or property. Except for the historic Mary W. Somers skipjack, the remaining structures in the SFHA are all categorized as buildings, sites, or both. Table 4.3.1-3 shows the six RNRE sites located in the SFHA, all of which are located in the unincorporated areas of Charles County.

Table 4.3.1-3: RNRE Sites Located in the SFHA

NAME	MIHPNO	JURISDICTION
Anthony's Pasture	CH-189	Charles County Unincorporated Areas
Christ Episcopal Church	CH-18	Charles County Unincorporated Areas
Governor Harry W. Nice Memorial Bridge	CH-376	Charles County Unincorporated Areas
Millbrook Farm Grist Mill	CH-193	Charles County Unincorporated Areas
Pasquahanza	CH-32	Charles County Unincorporated Areas
Plank Bridge Farm Corn Crib & Barn	CH-174	Charles County Unincorporated Areas

A full list of MIHP properties and their vulnerability to hazards discussed in this chapter can be found in Appendix D.

4.3.2 Erosion Vulnerability

To assess the vulnerability of historic and cultural resources to erosion, Charles County focused on the direct loss of land and its potential impact on these resources. The land vulnerable to loss was estimated based on a shoreline change transect database produced by Maryland Geological Survey (MGS). The database generalizes average annual erosion rates into five categories: accretion, 0-2 feet, 2-4 feet, 4-8 feet, and greater than 8 feet. To develop a conservative estimate of the land vulnerable to erosion, the highest average erosion rate in each category was assumed to prevail, and the average erosion rate was assumed to remain constant over the next 100 years. In 100 years' time, the shoreline was therefore estimated to retreat 200 feet for transects in the 0-2 feet per year category, 400 feet for transects in the 2-4 feet per year category, and 800 feet for the transects in the 4-8 feet per year and greater than 8 feet per year categories. Based on these assumptions, buffers were generated around the point at which each transect intersects the current shoreline, and the structures within the buffer area were identified. Note that this is an order of magnitude estimate. Erosion rates are highly variable across space and time and are dependent on many localized shoreline characteristics.

Table 4.3.2-1 displays the number of NRHP sites, MIHP site, and RNRE sites estimated to be vulnerable to erosion. A total of seven NRHP sites (17.07%) are in erosion hazard areas, while 59 MIHP sites (5.86%) are located in these areas. Of these 59 sites, eight are potentially eligible for the NRHP. All historic and cultural resources vulnerable to erosion are in the unincorporated areas of the County. NRHP sites vulnerable to erosion are listed in Table 4.3.2-2 while a list of RNRE sites can be found in Table 4.3.2-3. Additionally, while not shown in the table below, one cemetery (Lee Graves in Newburg) was located in an erosion-prone area. A full list of MIHP sites vulnerable to erosion can be found in Appendix D.

Table 4.3.2-1: Historic and Cultural Resources Vulnerable to Erosion

MUNICIPALITY	TOTAL NRHP SITES	TOTAL NRHP IN EROSION HAZARD AREA	PERCENT NRHP SITES IN EROSION HAZARD AREA	TOTAL MIHP SITES	TOTAL MIHP SITES IN EROSION HAZARD AREA	PERCENT MIHP SITES IN EROSION HAZARD AREA	TOTAL RNRE SITES	TOTAL RNRE SITES IN EROSION HAZARD AREA	PERCENT RNRE SITES IN EROSION HAZARD AREA
Charles County Unincorporated Areas	37	7	18.92%	886	59	6.66%	101	8	7.92%
Town of Indian Head	0	0	0.00%	0	0	0.00%	0	0	0.00%
Town of La Plata	2	0	0.00%	68	0	0.00%	10	0	0.00%
Village of Port Tobacco	2	0	0.00%	52	0	0.00%	1	0	0.00%
Total	**41**	**7**	**17.07%**	**1,006**	**59**	**5.86%**	**112**	**8**	**7.14%**

Of the seven NRHP resources determined to be vulnerable to erosion, three were buildings (Marshall Hall, Mount Air, and Waverly), three were larger sites or districts (Piscataway Park, the Mallows Bay-Widewater Historic and Archaeological District, and Mt. Aventine), and one was a historic skipjack (the Mary W. Somers). Several of these sites were also vulnerable to flooding, which informed the prioritization of sites in Section 4.4. Figure 4.3.2-2 depicts Mount Air, which is also vulnerable to flood and landslide.

Table 4.3.2-2: NRHP Sites Vulnerable to Coastal Erosion

NAME	TYPE	JURISDICTION
Waverley	Building	Charles County Unincorporated Areas
Mount Air	Building	Charles County Unincorporated Areas
Marshall Hall	Building	Charles County Unincorporated Areas
Mt. Aventine	District	Charles County Unincorporated Areas
Mallows Bay-Widewater Historic and Archaeological District	District	Charles County Unincorporated Areas
Mary W. Somers (Skipjack)	Object	Charles County Unincorporated Areas
Piscataway Park	Site	Charles County Unincorporated Areas

Please note that a district may contain multiple resources, not just one building. Additionally, individual building listings may contain multiple resources. As a result, there may be several buildings or resources included in an individual listing.

Overall, 59 of the 1,006 properties on the MIHP were determined to be vulnerable to erosion over a span of about 100 years. All of these properties were in the unincorporated areas of the County, and more than half were near the communities of Indian Head and Newburg. Most of the properties near Indian Head were related to the historic Naval Ordnance Station. Eight of the MIHP sites are potentially eligible for the NRHP and are shown in Table 4.3.2-3.

Figure 4.3.2-2: Image of Mount Air (NPS, 1978)

Table 4.3.2-1: RNRE Sites Vulnerable to Coastal Erosion

NAME	MIHPNO	JURISDICTION
Maiden Point Farm	CH-130	Charles County Unincorporated Areas
Hampton House	CH-144	Charles County Unincorporated Areas
Keechland	CH-158	Charles County Unincorporated Areas
Ravens Crest	CH-164	Charles County Unincorporated Areas
Pasquahanza	CH-32	Charles County Unincorporated Areas
Governor Harry W. Nice Memorial Bridge	CH-376	Charles County Unincorporated Areas
West Hatton	CH-39	Charles County Unincorporated Areas

4.3.3 Earth Disturbance (Landslide) Vulnerability

For purposes of assessing the vulnerability of historic and cultural resources to landslide, NRHP sites, MIHP sites, RNRE sites, and Historic Preservation Easements were intersected with landslide prone areas, which were defined as areas with slope grades of 15% or greater. For historic sites or districts that were represented as polygons rather than points, a site was deemed vulnerable to landslide if more than 50% of the site was located in an area with a slope grade of 15% or greater.

As shown in Table 4.3.3-1, nearly half of all NRHP sites are located in landslide hazard areas, while only 5.25% of MIHP sites and 8.04% of RNRE sites are located in these areas. Most of these sites are located in the unincorporated areas of the County, while Port Tobacco and La Plata also include vulnerable sites. Four of 14 historic preservation easements are also located in landslide-prone areas, all of which are located in Charles County's unincorporated areas. Additionally, six cemeteries (Speake Grave, St. Charles Catholic Church Cemetery, Trueman Graves, Sanders Graves, Fergusson Fuese Graves, and the Stone Cemetery at Habre de Venture) were located in landslide-prone areas. Figures 4.3.3-1 depicts two of the NRHP sites vulnerable to landslide.

Figure 4.3.3-1: Images of Maxwell Hall (Left) and Rose Hill (Right) (NPS, 1974; NPS 1973)

Table 4.3.3-1: Historic and Cultural Resource Vulnerability to Landslide

MUNICIPALITY	TOTAL NRHP SITES	TOTAL NRHP IN LANDSLIDE AREA	PERCENT NRHP SITES IN LANDSLIDE AREA	TOTAL MIHP SITES	TOTAL MIHP SITES IN LANDSLIDE AREA	PERCENT MIHP SITES IN LANDSLIDE AREA	TOTAL RNRE SITES	TOTAL RNRE SITES IN LANDSLIDE AREA	PERCENT RNRE SITES IN LANDSLIDE AREA	TOTAL HISTORIC PRESERVATION EASEMENTS	TOTAL HISTORIC PRES EASEMENTS IN LANDSLIDE AREA	PERCENT HISTORIC PRES EASEMENTS IN LANDSLIDE AREA
Charles County Unincorporated Areas	37	17	45.95%	886	51	5.76%	101	9	8.91%	14	4	28.57%
Town of Indian Head	0	0	0.00%	0	0	0.00%	0	0	0.00%	0	0	0.00%
Town of La Plata	2	0	0.00%	68	1	1.47%	10	0	0.00%	0	0	0.00%
Village of Port Tobacco	2	1	50.00%	52	1	1.92%	1	0	0.00%	3	0	0.00%
Total	**41**	**18**	**43.90%**	**1,006**	**53**	**5.27%**	**112**	**9**	**8.04%**	**17**	**4**	**23.53%**

Table 4.3.3-2 lists NRHP sites vulnerable to landslide. Of these 18 resources, 14 are buildings, two are districts, one is a site, and one is categorized as both a site and a district. Several of these resources, including Mount Air (Figure 4.3.2-2), were also determined to be vulnerable to the impacts of erosion and flood. Additionally, Rose Hill (Figure 4.3.3-1) is also vulnerable to flood and wildfire in addition to landslide.

Table 4.3.3-2: NRHP Sites Vulnerable to Landslide

NAME	TYPE	JURISDICTION
Araby	Building	Charles County Unincorporated Areas
Cedar Grove	Building	Charles County Unincorporated Areas
Ellerslie	Building	Charles County Unincorporated Areas
Habre de Venture	Building, Site	Charles County Unincorporated Areas
Linden	Building	Charles County Unincorporated Areas
Locust Grove	Building	Charles County Unincorporated Areas
Maxwell Hall	Building	Charles County Unincorporated Areas
Mount Air	Building	Charles County Unincorporated Areas
Mt. Aventine	District	Charles County Unincorporated Areas
Mt. Carmel Monastery	Site	Charles County Unincorporated Areas
Oak Grove	Building	Charles County Unincorporated Areas
Port Tobacco Historic District	District	Village of Port Tobacco
Rose Hill	Building	Charles County Unincorporated Areas
Rosemary Lawn	Building	Charles County Unincorporated Areas
Sarum	Building	Charles County Unincorporated Areas
St. Mary's Roman Catholic Church, Newport	Building	Charles County Unincorporated Areas
St. Thomas Manor	Building	Charles County Unincorporated Areas
Truman's Place	Building	Charles County Unincorporated Areas

Please note that a district may contain multiple resources, not just one building. Additionally, individual building listings may contain multiple resources. As a result, there may be several buildings or resources included in an individual listing.

MIHP sites in landslide hazard areas are shown in Table 4.3.3-3. All are located in unincorporated areas of the County, three of which are near La Plata while the other are located in Nanjemoy, Newburg, Faulkner, Benedict, Welcome, and Dentsville.

Table 4.3.3-3: RNRE Sites Vulnerable to Landslide

NAME	MIHPNO	JURISDICTION
Edgehill Farm	CH-148	Charles County Unincorporated Areas
Idaho	CH-166	Charles County Unincorporated Areas
Loch Leven Cornhouse	CH-684	Charles County Unincorporated Areas
Millbrook Farm Grist Mill	CH-193	Charles County Unincorporated Areas
Mount Pleasant	CH-298	Charles County Unincorporated Areas
Plank Bridge Farm Corn Crib & Barn	CH-174	Charles County Unincorporated Areas
Prospect Hill	CH-74	Charles County Unincorporated Areas

Table 4.3.3-3: RNRE Sites Vulnerable to Landslide		
NAME	MIHPNO	JURISDICTION
Robert Bowling House	CH-120	Charles County Unincorporated Areas
St. John AME Church	CH-366	Charles County Unincorporated Areas

4.3.4 Wildfire Vulnerability

For purposes of assessing the vulnerability of historic and cultural resources to wildfire, NRHP sites, MIHP sites, RNRE sites, and Historic Preservation Easements were intersected with Wildland Urban Interface (WUI) areas. This analysis only focused on WUI areas and not intermix areas due to the higher risk associated with WUI areas. As shown in Table 4.3.4-2, approximately 31.71% of structures in the County are located in WUI areas, including 10 sites in the unincorporated areas of the County, one site in La Plata, and two sites in Port Tobacco. Additionally, 340 MIHP sites (33.8%) are located in the WUI, including 75% of MIHP sites in the Town of La Plata. Of these 340 at-risk MIHP sites, 27 are potentially eligible for the NRHP. Additionally, five of 17 Historic Preservation Easements in Charles County are located in the WUI.

Table 4.3.4-1 illustrates that 11 of 13 NRHP sites located in the WUI are buildings, while the remaining two resources are historic districts (Bryantown and Port Tobacco). Additionally, Table 4.3.4-3 shows the 27 RNRE Sites in the WUI Area.

Table 4.3.4-1: NRHP Sites Vulnerable in WUI Area		
NAME	TYPE	JURISDICTION
Acquinsicke	Building	Charles County Unincorporated Areas
Araby	Building	Charles County Unincorporated Areas
Oak Grove	Building	Charles County Unincorporated Areas
Rose Hill	Building	Charles County Unincorporated Areas
Sarum	Building	Village of Port Tobacco
Spye Park	Building	Charles County Unincorporated Areas
St. Thomas Manor	Building	Charles County Unincorporated Areas
Stagg Hall	Building	Charles County Unincorporated Areas
The Hermitage	Building	Charles County Unincorporated Areas
The Lindens	Building	Village of Port Tobacco
Waverley	Building	Town of La Plata
Bryantown Historic District	District	Charles County Unincorporated Areas
Port Tobacco Historic District	District	Charles County Unincorporated Areas
Please note that a district may contain multiple resources, not just one building. Additionally, individual building listings may contain multiple resources. As a result, there may be several buildings or resources included in an individual listing.		

Table 4.3.4-2: Historic and Cultural Resource Vulnerability to Landslide

MUNICIPALITY	TOTAL NRHP SITES	TOTAL NRHP IN WUI AREA	PERCENT NRHP SITES IN WUI AREA	TOTAL MIHP SITES	TOTAL MIHP SITES IN WUI AREA	PERCENT MIHP SITES IN WUI AREA	TOTAL RNRE SITES	TOTAL RNRE SITES IN WUI AREA	PERCENT RNRE SITES IN WUI AREA	TOTAL HISTORIC PRES EASEMENTS	TOTAL HISTORIC PRES EASEMENTS IN WUI AREA	PERCENT HISTORIC PRES EASEMENTS IN WUI AREA
Charles County Unincorporated Areas	37	10	27.03%	886	261	29.46%	101	20	19.80%	14	2	14.29%
Town of Indian Head	0	0	0.00%	0	0	0.00%	0	0	0.00%	0	0	0.00%
Town of La Plata	2	1	50.00%	68	51	75.00%	10	6	60.00%	0	0	0.00%
Village of Port Tobacco	2	2	100.00%	52	28	53.85%	1	1	100.00%	3	3	100.00%
Total	**41**	**13**	**31.71%**	**1,006**	**340**	**33.80%**	**112**	**27**	**24.11%**	**17**	**5**	**29.41%**

Table 4.3.4-3: RNRE Sites in WUI Area		
NAME	MIHPNO	JURISDICTION
Bel Alton Historic District	CH-560	Charles County Unincorporated Areas
Black Friars	CH-42	Charles County Unincorporated Areas
Carrico Building	CH-344	Town of La Plata
Carrico House	CH-613	Charles County Unincorporated Areas
Cat Slide Roof House	CH-23	Village of Port Tobacco
Chillum	CH-354	Town of La Plata
Ellenwood	CH-33	Town of La Plata
Huckleberry Plains	CH-191	Charles County Unincorporated Areas
Idaho	CH-166	Charles County Unincorporated Areas
La Plata Historic District	CH-326	Town of La Plata
Maiden Point Farm	CH-130	Charles County Unincorporated Areas
Millbrook Farm	CH-192	Charles County Unincorporated Areas
Millbrook Farm Grist Mill	CH-193	Charles County Unincorporated Areas
Mt. Victoria	CH-35	Charles County Unincorporated Areas
Nanjemoy Store and Post Office, site	CH-194	Charles County Unincorporated Areas
Old Brick Jail	CH-178	Town of La Plata
Old Pomonkey High School	CH-503	Charles County Unincorporated Areas
Physicians Memorial Hospital	CH-806	Town of La Plata
Quaker Cemetery	CH-457	Charles County Unincorporated Areas
Rose Hill	CH-1	Charles County Unincorporated Areas
St. Johns Chapel	CH-251	Charles County Unincorporated Areas
St. Joseph's Church	CH-68	Charles County Unincorporated Areas
St. Paul's Episcopal Church	CH-226	Charles County Unincorporated Areas
Sunnyside	CH-214	Charles County Unincorporated Areas
West Hatton	CH-39	Charles County Unincorporated Areas
Westwood Manor	CH-151	Charles County Unincorporated Areas
Wright House	CH-356	Charles County Unincorporated Areas

4.4 Vulnerability Summary

Tables 4.4-1 and 4.4-2 summarize vulnerable for all NRHP sites and RNRE sites in Charles County. The tables show which hazards each resource is vulnerable to. In the following tables, a site's vulnerability to these hazards is noted with the following colors:

- Vulnerable to Flood - Blue
- Vulnerable to Erosion – Brown
- Vulnerable to Landslide – Green
- Vulnerable to Wildfire - Red

Each site was also assigned a priority score based on the results of this analysis. If a site was vulnerable to erosion, landslide, or wildfire, it received one point for each of these hazards, whereas if a site was located in the SFHA it received two points since flood is a high-risk hazard for Charles County. For example, the Port Tobacco Historic District received a priority score of four, as this resource was vulnerable to flood (2), landslide (1), and wildfire (1).

As shown in the tables, six resources on the NRHP (four buildings and 2 districts) received a priority score of four, while only one RNRE site (Millbrook Farm Grist Mill) received a score of four. County-owned assets are identified with an asterisk in both tables. Two County-owned historic sites (Old Waldorf School and Bel Alton High School) were not RNRE sites or vulnerable to any of the hazards analyzed, and therefore do not appear in the tables below.

A full list of MIHP sites and their vulnerability is available in Appendix D.

Table 4.4-1: **NRHP Site Vulnerability Summary and Prioritization**

NAME	TYPE	JURISDICTION	NRHP REFERENCE NUMBER	LISTED DATE	FLOOD (2)	EROSION (1)	LANDSLIDE (1)	WILDFIRE (1)	PRIORITY
Rose Hill	Building	Charles County Unincorporated Areas	73000914	1973-03-30					4
Port Tobacco Historic District	District	Village of Port Tobacco	79003911	1989-08-04					4
Sarum	Building	Charles County Unincorporated Areas	74000948	1974-08-13					4
Waverley	Building	Charles County Unincorporated Areas	75000886	1975-08-11					4
Mt. Aventine	District	Charles County Unincorporated Areas	94001328	1996-04-18					4
Mount Air	Building	Charles County Unincorporated Areas	78001453	1978-12-22					4
Bryantown Historic District	District	Charles County Unincorporated Areas	85000590	1985-03-14					3
The Lindens	Building	Charles County Unincorporated Areas	90000607	1990-04-23					3
Habre de Venture	Building, Site	Charles County Unincorporated Areas	72001595	1972-10-31					3
Piscataway Park	Site	Charles County Unincorporated Areas	66000144	1966-10-15					3
Mallows Bay-Widewater Historic and Archaeological District	District	Charles County Unincorporated Areas	15000173	2015-04-24					3
MARY W. SOMERS (skipjack)	Object	Charles County Unincorporated Areas	76002173	1976-10-08					3
Araby	Building	Charles County Unincorporated Areas	74000947	1974-07-25					2
Oak Grove	Building	Charles County Unincorporated Areas	83003777	1983-11-23					2
St. Thomas Manor	Building	Charles County Unincorporated Areas	88002050	1988-11-10					2

Table 4.4-1: **NRHP Site Vulnerability Summary and Prioritization**

NAME	TYPE	JURISDICTION	NRHP REFERENCE NUMBER	LISTED DATE	FLOOD (2)	EROSION (1)	LANDSLIDE (1)	WILDFIRE (1)	PRIORITY
McPherson's Purchase	Building	Charles County Unincorporated Areas	85000019	1985-01-03					2
St. Catharine	Building	Charles County Unincorporated Areas	74000950	1974-10-01					2
Timber Neck	Building, Site	Charles County Unincorporated Areas	79001123	1979-09-06					2
Thainston	District	Charles County Unincorporated Areas	90000436	1990-03-28					2
Stagg Hall*	Building	Village of Port Tobacco	88003061	1988-12-29					1
The Hermitage	Building	Town of La Plata	98000886	1998-06-17					1
Acquinsicke	Building	Charles County Unincorporated Areas	92000070	1992-02-20					1
Spye Park	Building	Charles County Unincorporated Areas	90001523	1990-10-04					1
Truman's Place	Building	Charles County Unincorporated Areas	87002264	1988-01-20					1
St. Mary's Roman Catholic Church, Newport	Building	Charles County Unincorporated Areas	91000603	1991-05-30					1
Rosemary Lawn	Building	Charles County Unincorporated Areas	92000380	1992-04-16					1
Cedar Grove	Building	Charles County Unincorporated Areas	79001124	1979-03-02					1
Ellerslie	Building	Charles County Unincorporated Areas	79003264	1979-09-24					1
Linden	Building	Charles County Unincorporated Areas	77000693	1977-11-23					1
Mt. Carmel Monastery	Site	Charles County Unincorporated Areas	73000913	1973-12-04					1

Table 4.4-1: **NRHP Site Vulnerability Summary and Prioritization**

NAME	TYPE	JURISDICTION	NRHP REFERENCE NUMBER	LISTED DATE	FLOOD (2)	EROSION (1)	LANDSLIDE (1)	WILDFIRE (1)	PRIORITY
Maxwell Hall*	Building	Charles County Unincorporated Areas	74000949	1974-07-30					1
Locust Grove	Building	Charles County Unincorporated Areas	78001454	1978-07-21					1
Marshall Hall	Building	Charles County Unincorporated Areas	76000152	1976-05-12					1
Johnsontown Tobacco Barn No. 2	Building	Charles County Unincorporated Areas	11000947	2011-12-27					0
Oakland	Building	Charles County Unincorporated Areas	83002946	1983-08-04					0
La Grange	Building	Town of La Plata	76000990	1976-10-22					0
The Exchange	Building	Charles County Unincorporated Areas	84001763	1984-06-07					0
Retreat	Building	Charles County Unincorporated Areas	88000222	1988-06-28					0
Rich Hill*	Building	Charles County Unincorporated Areas	75000885	1975-11-12					0
Green's Inheritance	Building	Charles County Unincorporated Areas	77000692	1977-12-16					0
Pleasant Hill	Building	Charles County Unincorporated Areas	97001449	1997-12-12					0

** Denotes County-owned properties.*

Table 4.4.1-1: RNRE Site Vulnerability Summary and Prioritization

NAME	JURISDICTION	MIHP NUMBER	FLOOD (2)	EROSION (1)	LANDSLIDE (1)	WILDFIRE (1)	PRIORITY
Millbrook Farm Grist Mill	Charles County Unincorporated Areas	CH-193					4
Plank Bridge Farm Corn Crib & Barn	Charles County Unincorporated Areas	CH-174					3
Governor Harry W. Nice Memorial Bridge	Charles County Unincorporated Areas	CH-376					3
Pasquahanza	Charles County Unincorporated Areas	CH-32					3
Maiden Point Farm	Charles County Unincorporated Areas	CH-130					2
West Hatton	Charles County Unincorporated Areas	CH-39					2
Idaho	Charles County Unincorporated Areas	CH-166					2
Anthony's Pasture	Charles County Unincorporated Areas	CH-189					2
Christ Episcopal Church	Charles County Unincorporated Areas	CH-18					2
Old Brick Jail	Town of La Plata	CH-178					1
Huckleberry Plains	Charles County Unincorporated Areas	CH-191					1
Chillum	Town of La Plata	CH-354					1
Wright House	Charles County Unincorporated Areas	CH-356					1
Old Pomonkey High School	Charles County Unincorporated Areas	CH-503					1
Carrico House	Charles County Unincorporated Areas	CH-613					1
St. Joseph's Church	Charles County Unincorporated Areas	CH-68					1
Quaker Cemetery	Charles County Unincorporated Areas	CH-457					1
Physicians Memorial Hospital	Town of La Plata	CH-806					1
Sunnyside	Charles County Unincorporated Areas	CH-214					1
Millbrook Farm	Charles County Unincorporated Areas	CH-192					1
Nanjemoy Store and Post Office, site	Charles County Unincorporated Areas	CH-194					1
St. Paul's Episcopal Church	Charles County Unincorporated Areas	CH-226					1
St. Johns Chapel	Charles County Unincorporated Areas	CH-251					1
La Plata Historic District	Town of La Plata	CH-326					1
Ellenwood	Town of La Plata	CH-33					1
Bel Alton Historic District	Charles County Unincorporated Areas	CH-560					1
Rose Hill	Charles County Unincorporated Areas	CH-1					1

Table 4.4.1-1: RNRE Site Vulnerability Summary and Prioritization

NAME	JURISDICTION	MIHP NUMBER	FLOOD (2)	EROSION (1)	LANDSLIDE (1)	WILDFIRE (1)	PRIORITY
Westwood Manor	Charles County Unincorporated Areas	CH-151					1
Cat Slide Roof House	Village of Port Tobacco	CH-23					1
Carrico Building	Town of La Plata	CH-344					1
Mt. Victoria	Charles County Unincorporated Areas	CH-35					1
Black Friars	Charles County Unincorporated Areas	CH-42					1
Edgehill Farm	Charles County Unincorporated Areas	CH-148					1
Mount Pleasant	Charles County Unincorporated Areas	CH-298					1
St. John AME Church	Charles County Unincorporated Areas	CH-366					1
Prospect Hill	Charles County Unincorporated Areas	CH-74					1
Loch Leven Cornhouse	Charles County Unincorporated Areas	CH-684					1
Robert Bowling House	Charles County Unincorporated Areas	CH-120					1
Hampton House	Charles County Unincorporated Areas	CH-144					1
Keechland	Charles County Unincorporated Areas	CH-158					1
Popes Creek Power Plant, Southern Maryland Tri-County Co-op Power Plant	Charles County Unincorporated Areas	CH-528					1
Ravens Crest	Charles County Unincorporated Areas	CH-164					1
The Napping	Charles County Unincorporated Areas	CH-108					0
Trinity Episcopal Church	Charles County Unincorporated Areas	CH-123					0
Marshall's Rest Property	Charles County Unincorporated Areas	CH-140					0
St. Matthew's Methodist Church	Charles County Unincorporated Areas	CH-186					0
Ellerslie	Charles County Unincorporated Areas	CH-24					0
Gunston	Charles County Unincorporated Areas	CH-28					0
La Plata Railroad Station	Town of La Plata	CH-351					0
Nanjemoy Baptist Church	Charles County Unincorporated Areas	CH-355					0
Eugene Chaney House	Charles County Unincorporated Areas	CH-374					0
Thomas Brown Log Dwelling	Charles County Unincorporated Areas	CH-377					0
Pisgah United Methodist Church	Charles County Unincorporated Areas	CH-505					0

Table 4.4.1-1: RNRE Site Vulnerability Summary and Prioritization

NAME	JURISDICTION	MIHP NUMBER	FLOOD (2)	EROSION (1)	LANDSLIDE (1)	WILDFIRE (1)	PRIORITY
Christ Episcopal Church	Town of La Plata	CH-62					0
Joseph Gray House-	Charles County Unincorporated Areas	CH-757					0
Brentfield	Charles County Unincorporated Areas	CH-139					0
Greenweich Boundary Markers	Charles County Unincorporated Areas	CH-165					0
Dent's Palace	Charles County Unincorporated Areas	CH-40					0
Hard Bargain	Charles County Unincorporated Areas	CH-41					0
Caroline Christ Farm	Charles County Unincorporated Areas	CH-425					0
Jesse M. Herbert Property	Charles County Unincorporated Areas	CH-469					0
St. Francis Catholic Chapel	Charles County Unincorporated Areas	CH-663					0
Plenty	Charles County Unincorporated Areas	CH-77					0
Shiloh Historic District	Charles County Unincorporated Areas	CH-787					0
Araby	Charles County Unincorporated Areas	CH-11					0
Old Fields Chapel	Charles County Unincorporated Areas	CH-112					0
Edelin Farm	Charles County Unincorporated Areas	CH-136					0
Betty's Delight	Charles County Unincorporated Areas	CH-153					0
Page Schoolhouse Property	Charles County Unincorporated Areas	CH-232					0
Rowe House	Town of La Plata	CH-339					0
William G. Chappelear Property	Charles County Unincorporated Areas	CH-445					0
Pleasant Gorve Baptist Church	Charles County Unincorporated Areas	CH-523					0
Greenland, Hanson's Conclusion	Charles County Unincorporated Areas	CH-603					0
Pleasant Hill	Charles County Unincorporated Areas	CH-301					0
Bowling Green	Charles County Unincorporated Areas	CH-215					0
Goode Road Log House, site	Charles County Unincorporated Areas	CH-778					0
Eutah	Charles County Unincorporated Areas	CH-79					0
St. Ignatius of Loyola Church, Hilltop	Charles County Unincorporated Areas	CH-97					0
Simpson's Coal Black, Simpkin Coatback	Charles County Unincorporated Areas	CH-657					0
Holly Springs	Charles County Unincorporated Areas	CH-109					0

Table 4.4.1-1: RNRE Site Vulnerability Summary and Prioritization

NAME	JURISDICTION	MIHP NUMBER	FLOOD (2)	EROSION (1)	LANDSLIDE (1)	WILDFIRE (1)	PRIORITY
Smallwood's Retreat	Charles County Unincorporated Areas	CH-12					0
Joseph C. Parks House	Charles County Unincorporated Areas	CH-143					0
Western View	Charles County Unincorporated Areas	CH-156					0
Brinkwood	Charles County Unincorporated Areas	CH-213					0
W.H. Winstead Co., Inc. Property	Charles County Unincorporated Areas	CH-435					0
Dudley & Lyon's Department Store	Charles County Unincorporated Areas	CH-489					0
Padgett-Posey House	Town of La Plata	CH-513					0
Gallant Green Store	Charles County Unincorporated Areas	CH-602					0
Calvary United Methodist Church	Charles County Unincorporated Areas	CH-622					0
Old Durham Church	Charles County Unincorporated Areas	CH-63					0
Sam Montgomery House	Charles County Unincorporated Areas	CH-644					0
Jameson Tenant Farm	Charles County Unincorporated Areas	CH-648					0
George J. Turner House	Charles County Unincorporated Areas	CH-656					0
Preference	Charles County Unincorporated Areas	CH-73					0
Mt. Aventine	Charles County Unincorporated Areas	CH-75					0
Hetty and Tom Wright House	Charles County Unincorporated Areas	CH-763					0
Wigwam	Charles County Unincorporated Areas	CH-797					0
Spearman Lancaster House	Charles County Unincorporated Areas	CH-85					0
Equality	Charles County Unincorporated Areas	CH-99					0
The Retreat	Charles County Unincorporated Areas	CH-10					0
Friendship Farm	Charles County Unincorporated Areas	CH-101					0
Herbert House	Charles County Unincorporated Areas	CH-119					0
Chandler's Hope	Charles County Unincorporated Areas	CH-124					0
Ellenborough	Charles County Unincorporated Areas	CH-138					0
Brentland Road House	Charles County Unincorporated Areas	CH-152					0
Huckleberry	Charles County Unincorporated Areas	CH-19					0
Holly Hall	Charles County Unincorporated Areas	CH-21					0

Table 4.4.1-1: RNRE Site Vulnerability Summary and Prioritization

NAME	JURISDICTION	MIHP NUMBER	FLOOD (2)	EROSION (1)	LANDSLIDE (1)	WILDFIRE (1)	PRIORITY
Locust Grove	Charles County Unincorporated Areas	CH-353					0
Crain's Lot	Charles County Unincorporated Areas	CH-36					0
Emory Chapel (Methodist)	Charles County Unincorporated Areas	CH-363					0
Society Hill	Charles County Unincorporated Areas	CH-37					0
Yatten	Charles County Unincorporated Areas	CH-38					0

4.5 Mitigation Solutions

Historic and cultural resources are invaluable and often irreplaceable assets, and it is essential to take action to reduce the potential impact of hazards to these resources. However, maintaining the historic character of a structure and undertaking site-specific mitigation actions can be a challenge. For example, replacing windows, doors, roofs, or other aspects of a historic structure could compromise its historic integrity if not done properly. Similarly, elevating a structure could have similar impacts if not undertaken with care. For example, elevating a historic structure can have minimal impacts if the façade of a structure is not drastically altered, and landscaping around a property can also reduce the visual impact of an elevation. When undertaking mitigation actions to protect historic sites and properties, it is important to ensure projects are preservation-sensitive. This is essential to maintain a site's integrity and eligibility for the NRHP and the MIHP, which provide access to certain funding streams and other benefits. Below are several strategies that can be considered when mitigating vulnerable historic properties, particularly the high-priority sites identified in Tables 4.4.1-1 and 4.4.1-2:

- Relocation of historic properties in flood prone areas
- Floodproofing and elevation-in-place
- Education and outreach to owners of historic properties
- Flood insurance
- Stormwater management projects on historic sites and in historic districts
- Preservation and restoration strategies
- Soil conservation and stabilization measures
- Water flow control and drainage programs
- Erosion control methods
- Erosion environmental impact assessments

Some specific actions that Charles County plans to undertake to build upon this analysis and reduce the vulnerability of its historic and cultural resources include the following. These actions are also incorporated in the Mitigation Strategy in Chapter 6.

1. **Create an Archaeological Context for Charles County:** This context would be developed based on a literature review of academic and historical works, and on information found in the archaeological data from the MHT. The Archaeological Context would be used to develop research questions and predict which sites that may answer those questions are located within high hazard areas. Finally, the County should conduct an Archaeological Survey of High Priority Sites in High Hazard Areas. This project should be undertaken in phases beginning with context development.
2. **Create an Expedited Review Process to be utilized post-incident:** An expedited historic property review process can include the identification of stabilization measures and minor repairs that can be completed without formal Historic Preservation Commission review. Similarly, Department of Planning and Growth Management staff can be authorized to approve certain changes utilizing Site Design and Architectural Review (SDAR) Guidelines when applicable. Planning and Growth Management staff, with clear guidance, can expedite permits for proposed work without the need

for a Historic Preservation Commission review meeting. This could expedite stabilization and provision of a weather-tight building enclosures, and reduce the administrative burden on property owners during the recovery process.

3. **Include Historic Properties in the County's Debris Management Plan:** One of the best tools for minimizing the loss of historic materials is to include a process to handle the salvage of these materials in the debris management plan. This can also be promoted as a sustainable alternative to disposal. To be effective, the plan should identify potential training opportunities for Department of Public Works personnel to learn how to sort debris and salvage historic materials and components rather than discard all debris in a landfill. Such trainings may be provided by the State of Maryland or FEMA. In the aftermath of a disaster, the salvaged items can be identified by property and made available to owners seeking to complete repairs.
4. **Establish a Demolition Delay Process to be utilized post-incident:** One of the tools that can provide time for a careful evaluation of threatened buildings is a demolition delay ordinance. In some communities, demolition delay ordinances are passed to allow time for owners of otherwise unprotected historic buildings to re-consider their options. In the aftermath of a flood event, it can provide time for qualified architects, engineers, and contractors to assess and stabilize a building. To protect public safety, one of the key provisions of a demolition delay ordinance is identifying a process by which a building official can approve the immediate demolition of a building or structure that is so compromised that it poses an immediate hazard or threat. Additionally, Charles County may want to embrace the model developed by Ellicott City and Preservation Maryland in response to the major 2016 flood event. Following the flood, a temporary resource center was established to provide technical assistance and guidance for preservation and rebuilding using financial incentives, such as historic tax credits, loans, and other funding sources. Preservation assistance was provided to over 78,000 square feet within the historic district (Preservation Maryland, 2017).
5. **Develop outreach and education to assist non-profits with the development of disaster plans:** This would help protect irreplaceable museum collections that might be impacted by hazard events. Museums are the caretakers of valuable and irreparable cultural assets in the form of artifacts as well as archaeological and archival collections. Comprehensive disaster planning and the use of best practices by these organizations is essential to the survival of these cultural collections.
6. **Develop disaster plans for historic sites and resources owned by Charles County:** Since Charles County owns several vulnerable, historic sites, it has the ability to undertake mitigation projects at these sites. Further assessing vulnerability and developing disaster plans for these resources will help the County determine how to best protect and preserve the historic assets under its jurisdiction.
7. **Targeted outreach to historic property owners:** Conduct targeted outreach to owners of at-risk high-priority historic properties about conservation-sensitive mitigation techniques and emergency preparedness
8. **Implement stormwater management and drainage improvements in flood-prone historic districts:** While not all assets are owned by the County or other public entities, infrastructure in historic districts often is. Implementing stormwater management and drainage improvement

projects nearby historic sites could help reduce the impact of flash flooding and potential losses. However, retrofitting projects should include an archaeological review.

Charles County will also consider undertaking the following steps to achieve long-term preservation goals:

- Make use of a broad range of preservation tools and strategies to permanently protect the County's most significant assets.
- Develop programs and strategies to educate the public about heritage resources and their preservation.
- Ensure that the historic preservation program has adequate resources to accomplish stated goals.
- Promote incentives to encourage heritage preservation programs and projects.
- Continue the survey and evaluation of all heritage resources including buildings, structures, archaeological sites, and historic landscapes, as well as living traditions and history museums.
- Promote heritage tourism initiatives throughout Charles County and the surrounding region.
- Continue to develop and implement preservation planning and review.
- Consider and minimize the impacts that elevation projects for non-historic properties have on historic structures and their setting.

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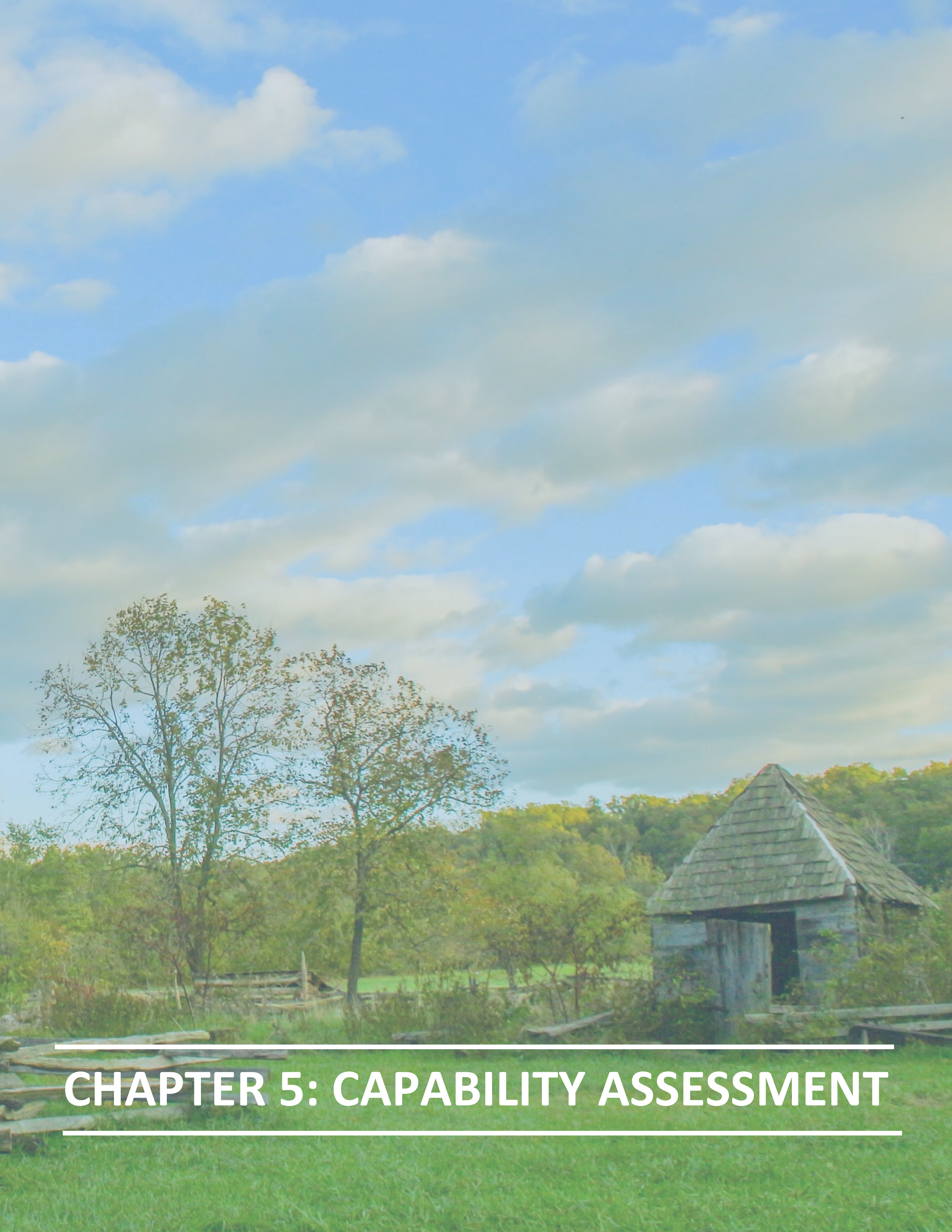


CHAPTER 5: CAPABILITY ASSESSMENT

5 Capability Assessment

This chapter identifies strengths and opportunities in Charles County's mitigation capabilities. Charles County has many existing programs, staff, and functions that can be adapted to mitigate hazards and reduce loss of life and property. These include programs related to emergency services, planning and growth management, public works, and parks and recreation, as well as functions related to program administration, technical analysis, financing, and outreach. Charles County also participates in many regional, state, and federal programs that can be coordinated with hazard mitigation goals. Together, these programs and capabilities can help Charles County build community resiliency through actions taken before, during, and after a hazard event. This chapter consists of the following subsections:

- Update Process Summary
- Capability Assessment Findings

5.1 Update Process Summary

A brief assessment of mitigation capabilities was provided in Chapter 3 of the 2012 HMP. The 2018 HMP updates and expands upon this assessment with new surveys of government officials and staff, more thorough reviews of existing planning mechanisms, and summaries of the plans and programs adopted since 2012.

One of the most effective ways of assessing local mitigation capabilities is to tap the knowledge of local officials and staff. The professionals who implement local programs on a day-to-day basis are generally in the best position to identify opportunities and challenges for hazard mitigation. To access this local knowledge, the HMPC distributed Capability Assessment Surveys to meeting participants at the Kick-Off Meeting on November 8, 2017 and via an email to key local staff. The survey included sections on relevant plans and regulations, staff expertise, and staff perceptions of mitigation capabilities. Fifteen responses were received, and the results are presented in Section 5.2.

Another effective way of assessing local mitigation capabilities is reviewing the plans, policies, and regulations that are "on the books." Analysis from the 2012 HMP, current information provided by the HMPC, and additional plans, programs, and funding sources were reviewed for opportunities to advance hazard mitigation. These opportunities were grouped into four categories of capabilities:

- Planning and Regulatory
- Administrative and Technical
- Financial Capability
- Education and Outreach

The findings for each category are summarized in Sections 5.2.1 through 5.2.4. These findings were woven into the mitigation strategies presented in Chapter 6.

5.2 Capability Assessment Findings

Local government services in Charles County are provided by the County, the Town of La Plata, and the Town of Indian Head. Port Tobacco Village has less than 10 residents and does not provide local services. The Charles County government serves the County's unincorporated areas, while the town governments serve the incorporated municipalities. This assessment addresses the programs, policies, regulations, and resources of each of these three jurisdictions. Opportunities for advancing hazard mitigation are identified, as well as gaps and barriers.

In general, most county staff and officials believe that Charles County has high planning and regulatory, administration and technical, and community political capabilities and resources, while the perception of county's fiscal capabilities is viewed as more limited. Tables 5.2.1-1 summarize the results of the Capability Assessment Survey distributed by the HMPC for county staff and officials. Table 5.2.1-2 summarizes these same capabilities by jurisdiction and illustrates that the Town of La Plata has the highest local capabilities.

Table 5.2.1-1: Summary of self-assessment capabilities responses from Charles County staff and officials expressed as a percentage of responses received

CAPABILITY CATEGORY	LIMITED	MODERATE	HIGH
Planning & Regulatory	22.2%	22.2%	55.6%
Administrative & Technical	33.3%	22.2%	44.4%
Fiscal	50.0%	25.0%	25.0%
Community Political	37.5%	12.5%	50.0%

Table 5.2.1-2: Summary of jurisdictional capabilities

COMMUNITY	PLANNING AND REGULATORY	ADMINISTRATIVE AND TECHNICAL	FISCAL	COMMUNITY POLITICAL
Town of La Plata	HIGH	HIGH	MODERATE	HIGH
Town of Indian Head	HIGH	MODERATE	MODERATE	MODERATE
Town of Port Tobacco Village	MODERATE	LIMITED	LIMITED	MODERATE

5.2.1 Planning and Regulatory Capability

Charles County boasts a robust planning and regulatory framework that is highly conducive to comprehensive mitigation planning. First, the County has access to a wealth of planning and regulatory tools that can limit exposure to hazards and reduce the impact when disaster strikes. Second, the County features a highly centralized local government structure. In contrast to the scores of municipal governments that exercise planning and regulatory authority in most counties in the Northeast, only three local governments exercise this authority in Charles County. To identify the most promising opportunities for enhancing mitigation planning, this section provides a summary of the key planning and regulatory tools in place in Charles County, along with their relationship to hazard mitigation. Three program areas are addressed: emergency management, land use and development, and floodplain management.

Emergency Management

Hazard Mitigation Plan

HMPs describe in detail the hazards that may affect the community, the community's vulnerability to those hazards, and an action plan for how the community plans to minimize or eliminate that vulnerability. Charles County and its incorporated municipalities actively participated in the development of the initial Multi-Jurisdictional HMP and in the development of the 2018 plan update. This update refreshes the community's blueprint for how it intends to reduce the impact of hazards on people and property.

Emergency Operations Plan

Last updated in 2012, the Charles County Emergency Operations Plan defines which people and resources will be deployed in response to emergencies or disasters that impact the County. The plan is meant to facilitate mitigation and preparedness as well as response and recovery, and represents a key opportunity for collaboration on hazard mitigation.

Continuity of Operations Plan

The Charles County Government Continuity of Operations Plan (COOP) was last updated in 2013 and provides the framework to restore essential functions in the event that county operations were impacted by an emergency. Potential impacts considered include loss of access to facilities, loss of services due to reduced workforce, and loss of services due to equipment or system failure. The COOP planning process incorporated an all-hazards approach and represents another opportunity for integration with hazard mitigation.

Land Use and Development

Comprehensive Plan

A community's comprehensive plan establishes the framework for future growth and serves as the official policy guide for decisions about how development will be managed, where and how it will occur, and what capital improvements and public services will support it. Charles County adopted a new comprehensive plan in 2016 that made significant changes to the previous plan. The 2016 comprehensive plan reduces the Development District by more than 30,000 acres, concentrates growth, enhances natural resource protections, promotes historic village revitalization efforts, and supports light rail transit for long term development. Each of these themes intersects with and supports hazard mitigation. The Land Use Plan's emphasis on concentrating growth in existing developed areas and preserving natural resources can support decisions to limit new development in hazard-prone areas and to protect features that reduce hazard impacts. To implement these goals, the comprehensive plan sets ambitious quantitative targets. Chapter 3 of the plan calls for 75 percent of future residential growth to be directed to the sewer service areas and the Towns of Indian Head and La Plata, while Chapter 5 calls for fifty percent of the County to be protected as open space. The comprehensive plan supports these land use goals with complementary goals for economic development and infrastructure. For example, Chapter 7 calls for the County to support revitalization and redevelopment of its aging urban centers, while Chapter 8 designates the construction of a light rail line from the Branch Avenue Metro Station to Waldorf/White Plains as a long-term transportation priority. Both measures support long-term development patterns that preserve the flood mitigation functions of living shorelines and limit the amount of new development in harm's way. Figure 5.2.1-1 shows the land use plan map from the 2016 Comprehensive Plan.

The La Plata and Indian Head comprehensive plans reflect the strength of interjurisdictional coordination in Maryland. The plans share many of the goals in the Charles County comprehensive plan, but establish slightly different policies tailored to the distinct history and character of each town. For example, the Indian Head comprehensive plan emphasizes tourism development in its town center to promote redevelopment and revitalization, while the La Plata comprehensive plan emphasizes measures to maintain and enhance the downtown's "sense of place."

Zoning Ordinances

Charles County's zoning ordinance is the primary mechanism for implementing its comprehensive plan. Generally speaking, the ordinance establishes a series of zoning districts and defines the goals, permitted uses, and design standards for each district. Charles County's zoning ordinance has many provisions that support hazard mitigation, mostly by designating where residential, commercial, and industrial development is allowed and delineating where natural resources are protected. Figure 5.2.1-2 shows the zoning map for the portion of the County just north of La Plata, and illustrates how base zones and overlay zones interact to protect sensitive natural resources. Overlay zones can be placed over fixed zoning districts to apply addition provisions that are either more restrictive or expansive. The zoning map below shows some areas as dark green with crosshatch. This area is subject to the provisions of both the Rural Residential Zoning District, and the Resource Protection Overlay Zone. The Resource Protection Overlay Zone adds stream buffer requirements to preserve floodplains and wetlands. Another overlay zone that protects natural resources is the Critical Area Zone, which restricts development within 1,000 feet of tidal waters in order to protect water quality and wildlife habitat.

Subdivision Regulations

Charles County's subdivision regulations guide the division and development of the County's land through a series of requirements for the preparation, submission, and review of subdivision and land development plans. Unlike the zoning ordinance, the subdivision regulations apply throughout the County. The regulations are intended to provide adequate sites for development and public use, to maintain reasonable design standards, and to coordinate public improvements with private development interests.

Among the Charles County subdivision regulations supporting hazard mitigation are the general site design standards and the subdivision application criteria. The general site design standards require a site design and environmental feature analysis, and require that sensitive natural features be preserved as open space to the extent practicable. To implement this requirement, a list of criteria is provided for all subdivision application. At all stages of development (pre-application concept, minor subdivision plat, major subdivision preliminary plat, and major subdivision final plat), extensive environmental information must be included in the plans, including "all existing streams, water courses, flood plains, tidal and non-tidal wetlands, or other environmentally sensitive areas on and within 200' of site; and all required State and County buffers for the above features." The County issued a "Green Notice" to residents about newly updated versions of the Subdivision Regulations and Zoning Ordinance posted on the County website.

Figure 5.2.1-1: Land Use Plan Map (Charles County, 2016)

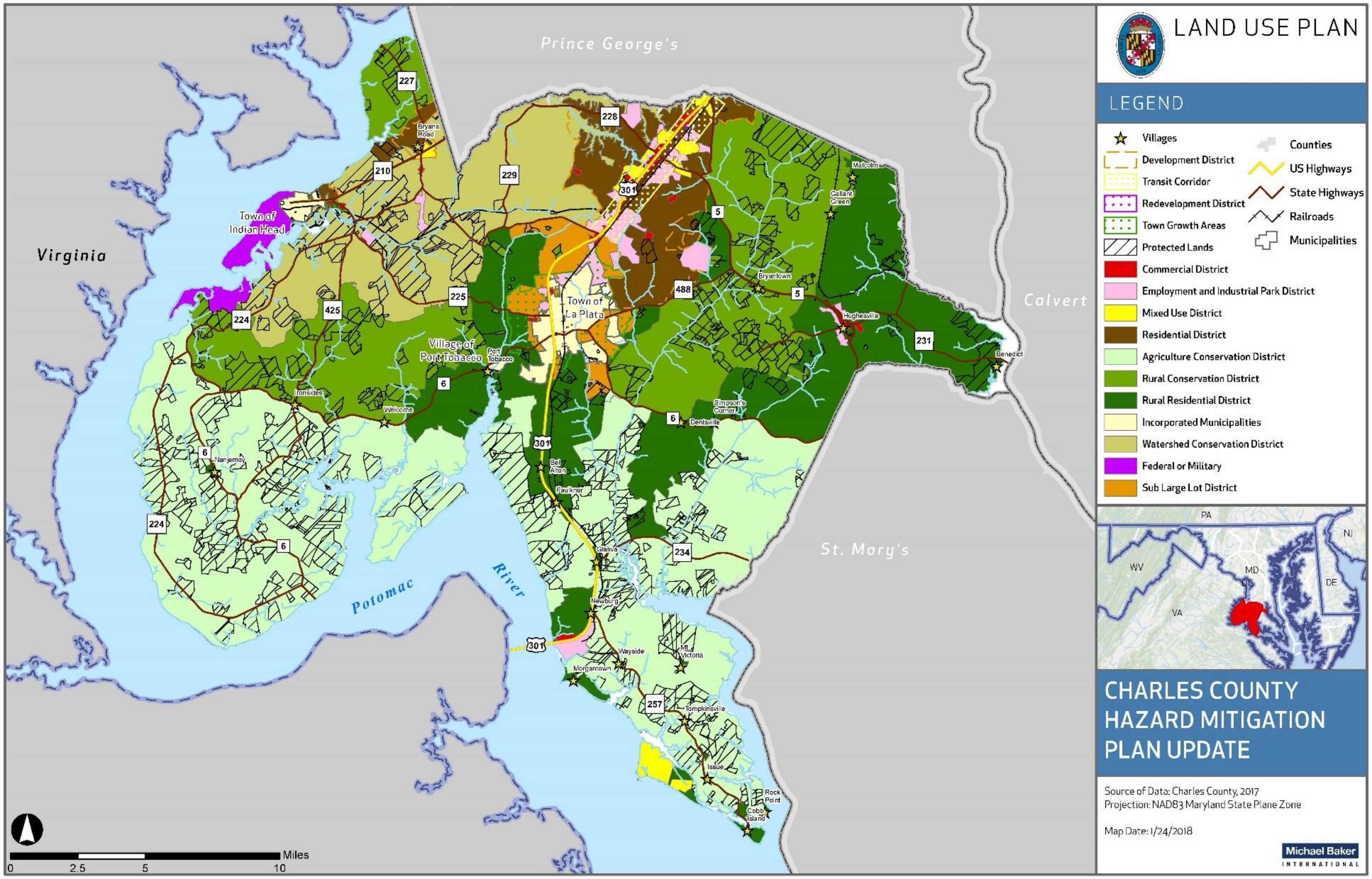
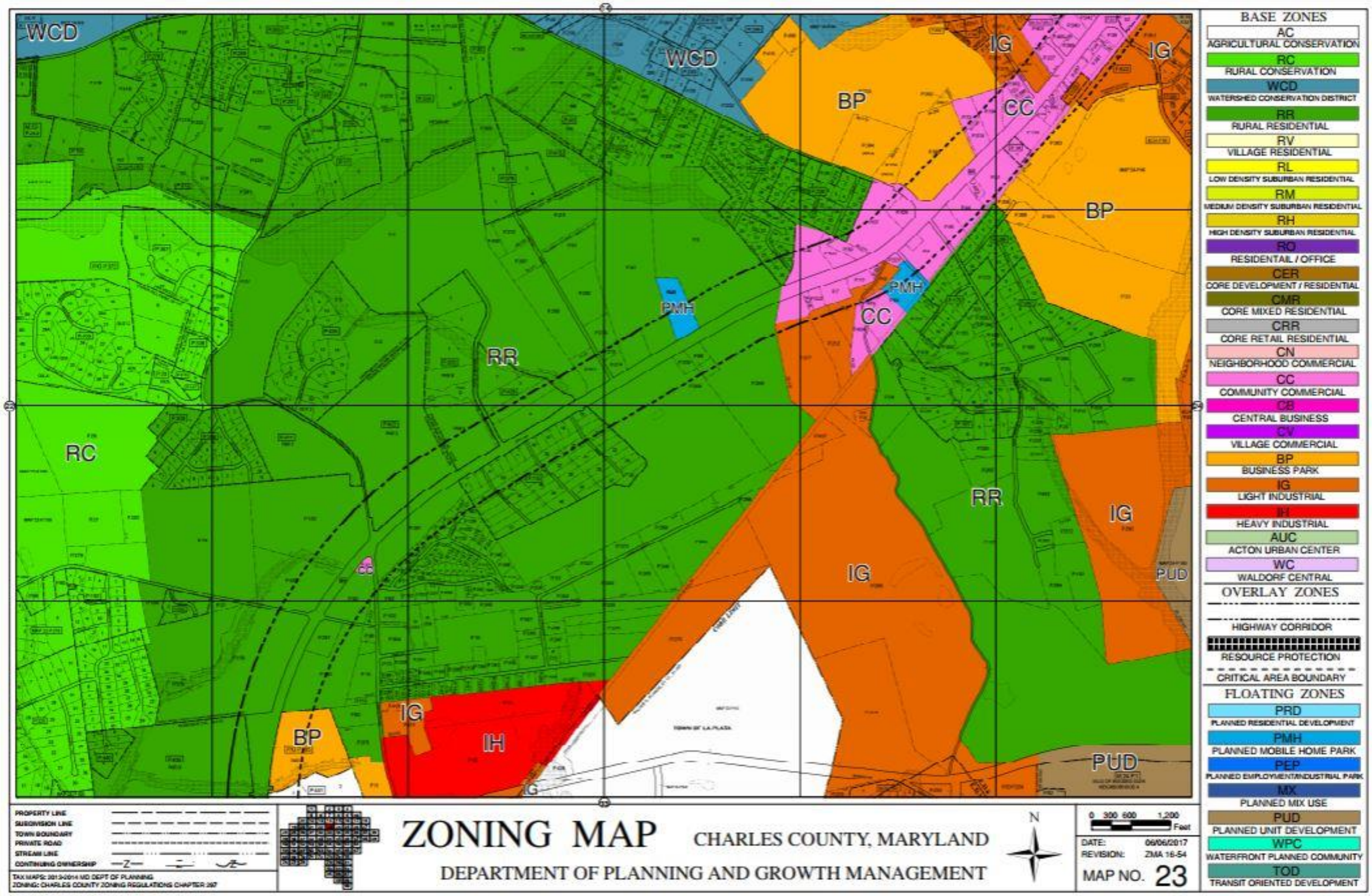


Figure 5.2.1-2: Charles County Zoning Map No. 23



Building Codes

A community's building code establishes regulations for the design, construction, alteration, and maintenance of structures. These regulations ensure both that new construction uses sound methods and materials, and that existing buildings are kept in a state of good repair. The use of strong building codes supports hazard mitigation by limiting the loss of life and property when disaster strikes.

In Charles County, all three local jurisdictions have adopted model building codes maintained by the International Code Council. While Charles County has adopted the International Building Code 2015, International Residential Code 2015, and the 2015 International Existing Building Code, the Town of Indian Head has adopted the International Building Code 2006, and the Town of La Plata has adopted the International Building Code 2003.

Charles County Comprehensive Water and Sewer Plan

Last revised in 2008, the Comprehensive Water and Sewer Plan designates where public water and sewer facilities are planned or available, and is an important mechanism for implementing the Comprehensive Plan. The goals of the Charles County Comprehensive Water and Sewer Plan include protecting sensitive areas and concentrating development in suitable areas.

Shoreline Assessment

Charles County is currently undertaking a planning effort for the National Pollutant Discharge Elimination System (NPDES) MS4 permit, and more broadly to increase coastal resilience within the County. The project is being managed by Southern Maryland Resource Conservation and Development (RC&D) and overseen by the Department of Planning and Growth Management. The immediate goal of the project is to determine areas in most need of shoreline erosion control in order to identify and undertake projects to earn credit toward the County's MS4 impervious surface restoration goals and Total Maximum Daily Load (TMDL) nutrient reduction credits. As a result of this initiative and resulting projects, coastal resilience will increase and thereby reduce the County's vulnerability to natural hazards and potential climate change impacts.

Charles County Capital Improvement Program

Each year, the County reviews and adopts both the current year budget and a five-year Capital Improvement Program. Capital improvements are long-term investments, typically in physical infrastructure. Incorporating hazards planning and projects into the capital improvements planning process is one way of enhancing Charles County's resilience to extreme weather and sea level rise.

Floodplain Management

In overseeing floodplain management, the Charles County Department of Planning and Growth Management has taken a unified, comprehensive approach which addresses natural floodplain functions and Federal and State programs associated with floodplain management. These programs are: the National Flood Insurance Program (NFIP), the Community Rating System (CRS), floodplain management ordinances, State Waterway Construction Permit Program for nontidal floodplains, the State's Tidal and Nontidal Wetlands Permit Programs, U.S. Army Corps of Engineers' Section 10 and 404 permit programs, and the State's Coastal Zone Management Program. Below is a summary of several of the major tools and programs utilized by the County for floodplain management.

National Flood Insurance Program

Flooding is one of the most frequent natural hazards to impact Charles County, but also one of the most well-understood hazards with one of the most well-developed mitigation programs. Since 1968, the federal government has administered the NFIP to reduce the impact of flooding in the United States. This program makes more affordable flood insurance available to communities that adopt and enforce floodplain management regulations that meet NFIP requirements. The NFIP also helps communities understand flood risk by mapping flood hazard areas. Participation in the NFIP helps build a community's mitigation capability for flood hazards. Table 5.2.1-1: summarizes NFIP participation for each of Charles County's local jurisdictions. Please note that the Town of Port Tobacco Village does not participate in the NFIP.

Table 5.2.1-1: Charles County NFIP Participation

MUNICIPALITY	NFIP ENTRY DATE	CURRENT EFFECTIVE MAP	NUMBER OF POLICIES	AMOUNT OF COVERAGE
Charles County Unincorporated	6/5/1985	5/4/2015	653	$173,838,700
Town of La Plata	4/17/1985	5/4/2015	27	$6,529,000
Town of Indian Head	10/15/1985	5/4/2015	8	$2,165,000

Charles County, La Plata, and Indian Head all participate in the NFIP and have adopted floodplain management ordinances as well as the most current FIRMs and FIS. Countywide FIRMs were published for Charles County on September 4, 2013 and May 4, 2015 for riverine and coastal areas respectively. These communities also support floodplain identification and mapping, enforce their floodplain ordinances, ensure floodplain mapping information is available to community members, and conduct outreach related to flood insurance.

Floodplain Identification and Mapping

Charles County provides paper copies of FIRMs and the FIS at the County Government Building for public review. Copies of FIRMs and the FIS are also available at the La Plata Town Hall and the Town of Indian Head Town Hall. Interested parties are also referred to www.mdfloodmaps.com to view digital copies of the maps. These communities also provide up-to-date information, GIS datasets, and other data to FEMA as requested. Applicants and staff also share technical information with FEMA that could result in map revisions within six months of creating or identifying the new data, typically via email. Charles County and the jurisdictions also support local floodplain determinations by researching and providing information about elevation certificates and using county topography data to review approximate elevations. The Charles County Department of Planning and Growth Management also maintains a record of approved Letters of Map Change.

Floodplain Management Ordinance and Enforcement

Charles County, La Plata, and Indian Head have all adopted updated floodplain management ordinances following FEMA publishing the May 4, 2015 FIRMs and FIS to meet the minimum requirements of the NFIP. Charles County and these communities have also gone beyond the minimum requirements, and the ordinances for all three jurisdictions regulate to the BFE plus two-feet of freeboard. Additionally, proposed subdivisions must demonstrate buildable area outside the SFHA. The county's floodplain management regulations are codified in Chapter 238 of its code of ordinances, and reference the building code, subdivision regulations, and zoning regulations. In addition to setting standards for development in the floodplain, the County's floodplain management ordinance establishes requirements for permit applications and designates a floodplain administrator to review these applications. The ordinances for the jurisdictions list similar requirements, and the ordinances for Indian Head, La Plata, and Charles County all regulate how permits are issued, the use of BFE and floodway data in reviewing subdivision proposals, identifying measures to keep new and substantially improved construction at or above the BFE, and maintaining elevation data for new or substantially improved structures. If there is a compliance issue, violation notices are posted, written notification with remedies are distributed, and court action is taken with fines if necessary. The ordinances are administered by the Charles County Department of Planning and Growth Management, La Plata Department of Planning, and Town of Indian Head Zoning Administrator.

Flood Insurance Outreach

As needed and when possible, Charles County and local staff explain to the public the importance of flood insurance, when it is required, why development is limited, and the benefits of participating in the NFIP. Mailings and public notices are also distributed to notify property owners about any changes to FIRMs that would impact insurance rates. Additionally, Charles County staff explains the importance of elevation certificates in relation to obtaining the most accurate flood insurance policy.

Community Rating System

Another federal program available to help build local mitigation capability for flood hazards is the Community Rating System (CRS). The CRS is a voluntary program available to NFIP-participating communities that aims to reduce flood damages to insurable property, strengthen and support the insurance aspects of the NFIP, and encourage a comprehensive approach to floodplain management. The CRS provides incentives in the form of insurance premium discounts for communities that exceed the minimum NFIP floodplain management requirements. While none of the jurisdictions in Charles County were participating in the CRS program as of August 2018, Charles County has taken steps to begin participating in the program and sent a letter of interest to FEMA in September 2017, and the county floodplain manager became a designated CRS Coordinator in February 2018. Participation in CRS represents a significant opportunity to enhance the County's mitigation capability for flood hazards.

Table 5.2.1-2: Summary of planning tools adopted by each municipality in Charles County

Community	Hazard Mitigation Plan	Emergency Operations Plan	Evacuation Plan	Continuity of Operations Plan	Floodplain Management Ordinance	Zoning Regulations	Subdivision Regulations	Comprehensive Plan	Stormwater Management Plan	Natural Resource Protection Plan	Capital Improvement Plan	Firewise Community	Storm Ready	Building Code
Charles County	X	X	X	X	X	X	X	X	X	X	X		X	X
Town of La Plata	X	X		X	X	X	X	X	X				X	X
Town of Indian Head	X				X	X	X							X
Town of Port Tobacco Village	X													

5.2.2 Administrative and Technical Capability

Administrative and technical capability refers to the community's personnel and the range of skills and tools they can mobilize to implement hazard mitigation actions. Common examples of personnel and skill sets needed for hazard mitigation include: planners with knowledge of land development and management practices; engineers and code inspectors trained in construction practices; planners, scientists, and engineers familiar with hazards in the community; emergency managers; floodplain managers; land surveyors; personnel skilled in geographic information systems; resource development staff or grant writers; and administrative staff to handle complex grant application processes.

Based on an assessment of local departments and personnel (see Table 5.2.2-1), Charles County and its municipalities were found to have administrative and technical staff needed to implement hazard mitigation activities. The county has key capabilities across all categories throughout its departments, while the capabilities of the jurisdictions are largely related to planning and grant writing. These communities also vary in staff size, resource availability, fiscal status, service provision, population, overall size, and vulnerability to the profiled hazards.

Table 5.2.2-1: Summary of administrative and technical capabilities for Charles County

JURISDICTION	LAND USE/ DEVELOPMENT PLANNING	ENGINEERING	EMERGENCY MANAGER	FLOODPLAIN MANAGER	GIS	GRANT WRITING/FISCAL STAFF	PLANNING COMMISSION
Charles County Unincorporated	X	X	X	X	X	X	X
Town of Indian Head	X					X	X
Town of La Plata	X					X	X
Town of Port Tobacco Village							

Charles County's local jurisdictions can also consult with state and federal agencies to supplement their administrative and technical capabilities. State agencies which can provide technical assistance for mitigation activities include, but are not limited to:

- Maryland Emergency Management Agency
- Maryland Department of Planning
- Maryland Department of Natural Resources
- Maryland Department of the Environment

Federal agencies which can provide technical assistance for mitigation activities include, but are not limited to:

- Army Corp of Engineers
- Department of Housing and Urban Development (HUD)
- Department of Agriculture (DOA)
- Economic Development Administration
- Environmental Protect Agency (EPA)
- Federal Emergency Management Agency (FEMA)
- Small Business Administration

5.2.3 Financial Capability

All mitigation actions share a common challenge: who will pay and with what money? Though some mitigation actions are less costly than others (for example, the staff time required to enforce codes will likely cost less than the acquisition of flood-prone properties), all mitigation actions require some expenditure of limited resources.

To assess the financial capability of Charles County, the HMPC examined the diversity of the County's revenue sources and the favorability of the County's bond rating. In the State of Maryland, state grants are the largest revenue source for most county governments (27.7%), followed by the property tax (26.7%), the income tax (17.0%), service charges (11.7%), and federal grants (7.3%). Charles County's revenue sources reflect the state profile, but show a greater reliance on property taxes (29%) and state grants (31.5%). The county also receives a robust 12% of county revenues from service charges (Department of Legislative Services, 2016). These service charges are directed to Enterprise Funds that are separate from the General Fund and that support the services that consumers receive. Charles County's Enterprise Funds include the Water and Sewer Fund, Solid Waste Fund, Environmental Services Fund, Watershed Protection and Restoration Fund, and Inspection and Review Fund. Charles County's diverse revenue sources and separate Enterprise Funds give the County significant flexibility in financing mitigation projects.

The HMPC also considered the County's bond rating. Often, financing public infrastructure requires borrowing funds in the form of County Government bonds. Before bonds are issued, however, the County is required to obtain a rating from the national bond rating agencies. Financial ratings range from AAA, the highest rating, to C, the lowest rating. The higher the rating, the more confidence investors have in the County's ability to repay its bond issues, and the lower the interest rates will be. Charles County recently presented its case to the three national bond rating agencies, and received AAA bond rating from each one (Charles County, 2017)

Grant programs that have a nexus with hazard mitigation planning can also assist in offsetting the expenses of local mitigation actions. A detailed list of funding sources and programs can be in found in Appendix A.

5.2.4 Education and Outreach

Education and outreach activities can help implement mitigation activities and communicate hazard-related information. Examples include fire safety programs that fire departments deliver to students at local schools; participation in community programs such as Firewise Communities or StormReady Communities; and activities conducted as part of hazard awareness campaigns, such as Tornado or Flood Awareness Month. Some communities also have separate public information or communications offices to handle outreach initiatives.

Charles County's Department of Emergency Services offers a number of education and outreach programs. In 2017, the Department of Emergency Services published its Emergency Preparedness Guide to educate residents about disaster preparedness and provide tips and suggestions. This publication also describes types of hazards and what to do before, during, and after a disaster event. To help residents prepare for storms, the Department of Emergency Services has met all the requirements of the National Weather Service's StormReady Program. These include establishing a 24-hour warning point and emergency operations center, developing a redundant communication system for receiving severe weather warnings and forecasts and alerting the public, creating a system that monitors weather conditions locally, promoting the importance of public readiness, and developing a formal hazardous weather plan that includes training severe weather spotters and holding emergency exercises. The Department also offers safety education and training through the Charles County Volunteer Fire & EMS program.

Charles County has several platforms that could be adapted to communicate hazard-related information to the public. First, the County has a Public Information Office that provides vital information to the public during emergencies, responds to media inquiries, and coordinates news conferences. Second, for those interested in building or renovating a property, the County has a wealth of information on the web pages for the Department of Planning and Growth Management. These webpages include an interactive map that provides access to planning and regulatory information. An opportunity exists to make this map more prominent and to integrate more hazard information.

5.2.5 Plan Integration

Charles County can enhance its mitigation capabilities by integrating hazard mitigation plans and other community plans. As FEMA emphasizes in its guide to Plan Integration, this process involves a two-way exchange of information. Plan integration involves the incorporation of community planning mechanisms into hazard mitigation plans, as well as the incorporation of hazard mitigation principles and practices into community plans.

Community planning mechanisms are primarily incorporated into this HMP update in two places: the Land Use and Development Trends section of each hazard profile, and the Mitigation Strategy chapter. For each hazard, the HMPC compared the Land Use Map included in the Charles County Comprehensive Plan to the distribution of hazard risk. The HMPC then identified any areas where future growth would be exposed to high hazard risk and recommended changes. The Mitigation Strategy chapter further incorporated community planning mechanisms by tailoring recommended strategies and actions to the County's existing planning framework. Specifically, the results of the planning and regulatory capability assessment were used to identify mitigation activities that build upon existing plans, policies, and ordinances.

As discussed in Section 5.2.1, Charles County has a wealth of planning and regulatory tools that can reduce exposure and vulnerability to natural hazards. While Section 5.2.1 provides a brief summary of these tools and their relationship to hazard mitigation, this section provides a detailed evaluation of several key tools and the extent to which they are integrated with hazard mitigation. The tools targeted for evaluation are the comprehensive plan, zoning ordinance, and subdivision regulations, and the jurisdiction selected for evaluation is Charles County. The evaluation presented below is adapted from the Safe Growth Audit, a tool first proposed by David Godschalk in the 2009 issue of Zoning Practice.

Table 5.2.5-1: Evaluation of plan integration in Charles County			
KEY QUESTION	**FINDING**	**SECTION/ REFERENCE**	**COMMENTS**
COMPREHENSIVE PLAN			
Does the future land-use map clearly identify natural hazard areas?	In Part	Figure 3-1	The future land use map identifies the Chesapeake Bay Critical Area, Protected Lands, and Major Stream Valleys.
Do the land-use policies discourage development or redevelopment within natural hazard areas?	In Part	Chapters 3 and 5	The Land Use chapter includes the goal of protecting the County's natural resources, and the Natural Resources chapter includes the goal of preserving sensitive natural features. While there is significant overlap between sensitive natural features and natural hazard areas, they are not necessarily the same.
Does the plan provide adequate space for expected future growth in areas located outside natural hazard areas?	Yes	Chapter 3	The plan calls for growth to be concentrated in the sewer service areas and the Towns of Indian Head and La Plata.
Does the transportation plan limit access to hazard areas?	No	Chapter 8	The Transportation chapter does not explicitly address hazard areas.
Is transportation policy used to guide growth to safe locations?	No	Chapter 8	The Transportation chapter does not explicitly address hazard areas.
Are environmental systems that protect development from hazards identified and mapped?	No	Chapter 5	The Natural Resources chapter does not explicitly map protective environmental systems.
Do environmental policies maintain and restore protective ecosystems?	Yes	Chapter 5	The plan includes a series of policies and actions to protect floodplains, steep slopes, forest lands, shorelines, and Chesapeake Bay Critical Areas.
Do environmental policies provide incentives to development that is located outside protective ecosystems?	Yes	Chapters 3 and 5	Incentives are provided for preserving natural features through clustering and transfer of development rights.
Are the public safety goals and policies of the comprehensive plan related to those of the County Hazard Mitigation Plan?	In Part	Chapter 9	The County Hazard Mitigation Plan is described, but its goals and policies are not addressed.

Table 5.2.5-1: Evaluation of plan integration in Charles County			
KEY QUESTION	FINDING	SECTION/ REFERENCE	COMMENTS
Is public safety explicitly included in the plan's growth and development policies?	Yes	Chapters 3 and 10	The Land Use chapter and Community Development chapter both include policies emphasizing safety.
ZONING ORDINANCE			
Does the zoning ordinance conform to the comprehensive plan in terms of discouraging development or redevelopment within natural hazard areas?	Yes	Zoning Map, Article IX, Article XI	Although the zoning ordinance and map conforms to the comprehensive plan, the comprehensive plan does not explicitly identify natural hazard areas.
Does the ordinance contain natural hazard overlay zones that set conditions for land use within such zones?	In Part	Article IX, Article XI	The ordinance contains a Critical Area Overlay Zone and Resource Protection Overlay Zone to protect sensitive natural features. While there is significant overlap between sensitive natural features and natural hazard areas, they are not necessarily the same.
Does the ordinance prohibit development within, or filling of, wetlands, floodways, and floodplains?	Yes	Article XI, § 297-170	The zoning ordinance states that the land within this zone is to remain in an undisturbed natural state
SUBDIVISION REGULATIONS			
Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas?	In Part	Article V, Section 44(b)(iii)	The subdivision regulations restrict the development of sensitive natural features. While there is significant overlap between sensitive natural features and natural hazard areas, they are not necessarily the same.
Do the regulations provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources?	Yes	Article V, Section 48	The subdivision regulations briefly address cluster subdivisions, but more detail is provided in Article XIV of the zoning regulations.

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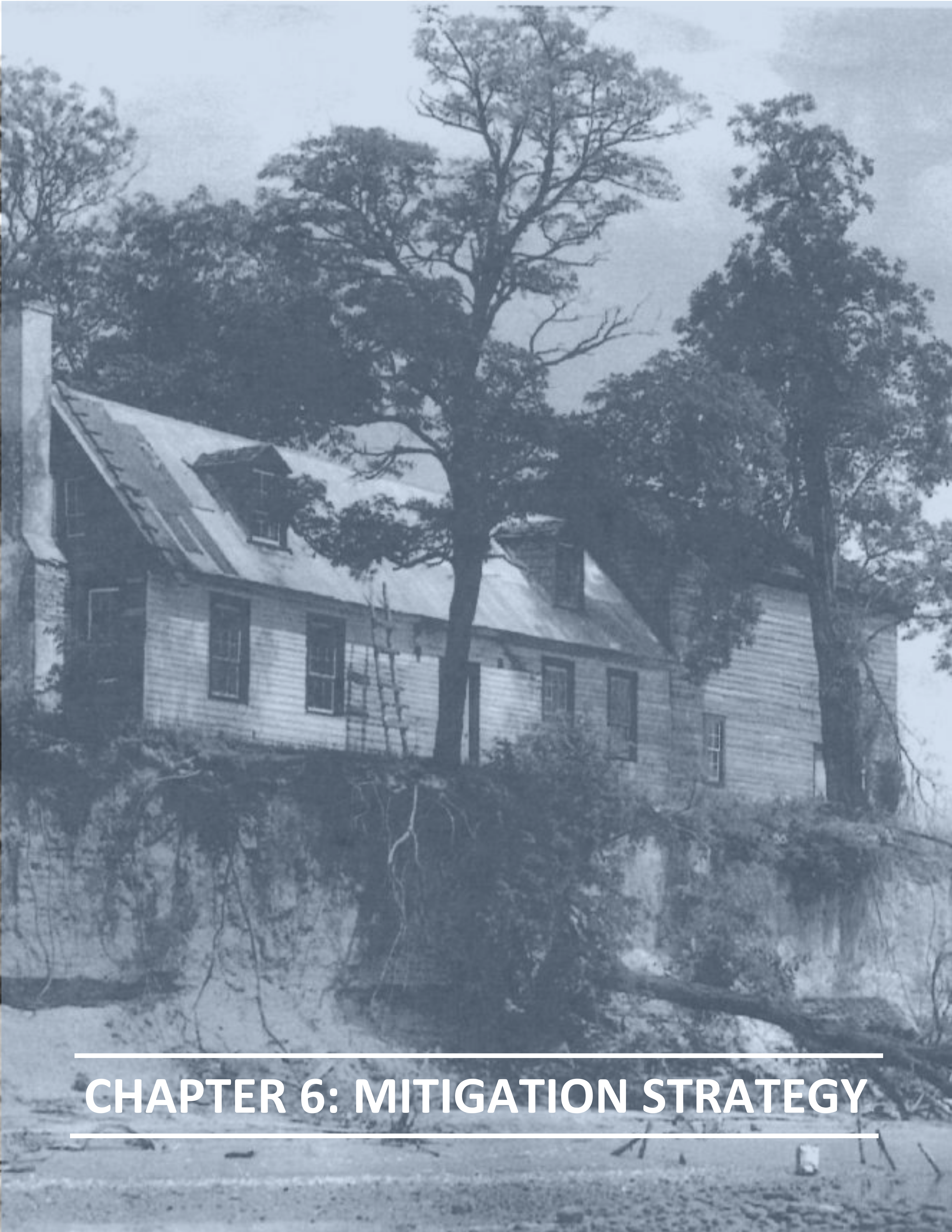

CHAPTER 6: MITIGATION STRATEGY

6 MITIGATION STRATEGY

This section of the Plan provides the "blueprint" for Charles County and participating municipalities to become less vulnerable to natural and human-caused hazards. It is based on the consensus of the Charles County HMPC along with the findings of the Hazard Identification and Risk Assessment (HIRA). This section consists of the following subsections:

- Update Process Summary
- Mitigation Goals and Objectives
- Identification and Analysis of Mitigation Techniques
- Mitigation Action Plan

The intent of the Mitigation Strategy is to provide Charles County and participating municipalities with the goals that will serve as the guiding principles for future mitigation policy and project administration, along with a list of proposed actions deemed necessary to meet those goals and reduce the impact of natural and human-made hazards. It is designed to be comprehensive and strategic in nature. The development of the strategy included a thorough review of natural and human-made hazards and identified policies and projects intended to not only reduce the future impacts of hazards, but also to help Charles County and participating municipalities achieve compatible economic, environmental and social goals. The development of this section is also intended to be strategic, in that all policies and projects are linked to establish priorities assigned to specific departments or individuals responsible for their implementation and assigned target completion deadlines. Funding sources are identified that can be used to assist in project implementation.

- Mitigation goals are general guidelines that explain what the County wants to achieve. Goals are usually expressed as broad policy statements representing desired long-term results.
- Mitigation objectives describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date.
- Mitigation Actions provide more detailed descriptions of specific work tasks to help the County and its municipalities achieve prescribed goals and objectives.

6.1 Update Process Summary

The HMPC reviewed the goals, objectives, and actions identified in the 2012 HMP to assess their relevance based on the updated risk assessment and the progress made implementing the Mitigation Strategy over the past five years. This process included a full review of mitigation goals, objectives, and actions, as well as an identification of mitigation successes. After the HMPC completed the review of the Mitigation Strategy, they identified additional mitigation actions to meet the current goals and objectives. Updating and developing new mitigation actions represent the key outcome of the mitigation planning process. The mitigation action plan includes a prioritized list of proposed hazard mitigation actions (policies and projects) for Charles County and its municipalities, including accompanying information such as those agencies or individuals assigned responsibility for their implementation, potential funding sources, and an estimated target date for completion. The action plans provide those individuals or agencies responsible for implementing mitigation actions with a clear roadmap that also serves as a valuable tool for monitoring progress over time.

6.1.1 Mitigation Goals and Objectives Review

Mitigation goals are general guidelines that explain what the County wants to achieve. Goals are usually expressed as broad policy statements representing desired long-term results. Mitigation objectives describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date.

The Charles County HMPC reviewed the 8 goals and 31 objectives in the 2012 HMP and determined that they remained relevant and reflected the overall purpose of the 2018 HMP; however, several goals were slightly revised and several new goals and objectives were added. The review of changes is shown in Table 6.1-1, while the full list of updated goals and objectives, including the additional goals and objectives added for 2018, is shown in Table 6.2-1.

Table 6.1-1: **Review of 2012 HMP Goals and Objectives**

Goal and objectives		Comments
Goal 1	Protect existing natural resources and preserve environmentally sensitive areas where hazard potential is high.	Continued
Objective 1A	Protect existing natural resources and open space, including parks and wetlands, within the floodplains.	Continued
Objective 1B	Restore degraded natural resources and open space to improve their flood control function.	Continued
Objective 1C	Preserve areas where natural hazard potential is high such as steeply sloping areas, sinkhole areas.	Continued
Goal 2	Promote disaster-resistant future development.	Continued
Objective 2A	Minimize future damage due to flooding by promoting resistant construction, retrofitting techniques and in the rural areas by erosion/sedimentation control practices.	Continued
Objective 2B	Regulate construction/ development in the County to prevent increases in runoff and subsequent increases in flood flows.	Reworded to "*Regulate construction and development in the County to minimize increases in impervious surfaces to reduce runoff and flood risk.*"
Objective 2C	Ensure that new construction is resistant to natural hazards.	Reworded to specify how this will be accomplished: "*Ensure that new construction is resistant to natural hazards by adhering to floodplain regulations, building codes, and land use and development regulations.*"

Table 6.1-1: Review of 2012 HMP Goals and Objectives		
Goal and objectives		**Comments**
Goal 3	Attempt to reduce the current and future risk of flood damage.	Continued
Objective 3A	Continue to participate in the National Flood Insurance Program.	Continued
Objective 3B	Reduce County roads vulnerability to flooding.	Reworded to "Reduce the vulnerability of County roads and other infrastructure to the impacts of flooding."
Objective 3C	Reduce flood damage by directing new development away from high hazard areas by reviewing existing regulations to ensure adequacy in reducing the amount of future development in identified hazard areas.	Reworded to "Ensure regulations reduce the amount of future development in identified flood hazard areas."
Objective 3D	Evaluate and update existing floodplain ordinances to meet or exceed the NFIP standards and evaluate impacts of sea level rise.	Continued
Objective 3E	Address stormwater issues in existing communities.	Continued
Goal 4	Reduce the potential impacts of natural and man-made disaster on public and private property.	Continued
Objective 4A	Address rural fire protection measures.	
Objective 4B	Ensure adequate public safety infrastructure.	
Objective 4C	Address problems regarding adequate water supply.	
Objective 4D	Reduce the vulnerability of the County to High Hazard Dams.	Reworded to "*Reduce the vulnerability of life, property, and infrastructure within the County to High Hazard Dams.*"
Objective 4E	To minimize the impact of winter weather to life and property to include buildings, infrastructure, critical facilities, and critical infrastructure.	Reworded to "*Minimize the impact of winter weather on life, property, buildings, critical facilities, and infrastructure*."
Objective 4F	Provide enhanced trainings, equipment, and plans for hazardous materials for emergency response and mitigation in Charles County.	Reworded to "*Reduce vulnerability to environmental hazards by providing enhanced trainings, equipment, and plans for emergency response and mitigation.*"
Objective 4G	Continue to monitor low risk hazards based on Risk Factor (RF) Methodology and modify the plan if risk should change before the plan needs to be updated.	Continued

Table 6.1-1:	Review of 2012 HMP Goals and Objectives	
Goal and objectives		Comments
Goal 5	Protect public health, safety, and welfare by increasing the public awareness of existing hazards (those identified by this 2011 plan update) and by fostering both individual and public responsibility in mitigating risks due to those hazards	Reworded to "Protect public health, safety, and welfare by increasing public awareness of existing hazards (those identified in the 2018 HMP Update) and by fostering both individual and public responsibility in mitigation the potential impacts and risks of those hazards."
Objective 5A	Develop and distribute public awareness materials about natural hazard risks, preparedness, and mitigation.	Continued
Objective 5B	Target owners of properties within identified hazard areas for additional outreach regarding mitigation and disaster preparedness.	Continued
Objective 5C	Coordinate with organizations that provide services to identified special populations.	Continued
Goal 6	Identify high risk hazard areas and ultimately areas where hazards can be mitigated.	Continued
Objective 6A	Direct Tier II facilities development away from high risk infrastructure such as schools and community based organizations.	Continued
Objective 6B	Collect all necessary data and develop commodity study.	Continued
Goal 7	Provide adequate care during hazard events to prevent/reduce damage to lives and property during hazard events.	Reworded to "*Provide adequate care during hazard events to prevent or reduce damage to lives and property.*"
Objective 7A	Evacuation information readily available for entire county.	Reworded to "Ensure evacuation information is readily available throughout the County"
Objective 7B	Address evacuation for special populations.	Reworded to "Ensure evacuation needs for special populations are met."
Objective 7C	Reduce impact of an outbreak by providing information and care regarding infectious diseases such as H1N1.	Reworded to “H1N1” to “influenza.”
Goal 8	Improve communications throughout the County including public and private the stakeholders.	Reworded to address coordination among county departments and jurisdictions as well as to promote plan integration *“Improve communications, planning, and coordination throughout the County, including among county departments, jurisdictions, and both public and private stakeholders.*"

Table 6.1-1: Review of 2012 HMP Goals and Objectives		
Goal and objectives		Comments
Objective 8A	Ensure all areas including rural portions of the County are in communication with the County at all times.	Continued
Objective 8B	Provide information to critical infrastructure, schools, and community based organizations as soon as possible from the EOC.	Continued
Objective 8C	Provide adequate, safe, and efficient evacuation routes and shelters during hazard events.	Continued
Objective 8D	Implement effective emergency warning systems throughout the County.	Continued
Objective 8E	Ensure that local officials are well trained regarding natural hazard and appropriate prevention and mitigation activities and improve communications between the public and emergency management services.	Continued

6.1.2 Mitigation Action Review

Mitigation actions provide detailed descriptions of specific work tasks to accomplish in order to achieve the mitigation goals and objectives. There were 47 actions identified in the 2012 HMP, which members of the HMPC reviewed during and following Mitigation Solutions Workshop on December 13, 2017. Additionally, Charles County and the municipalities received copies of the 2012 mitigation actions for their review during the planning process. When reviewing the actions, members of the HMPC noted whether actions were completed, ongoing, canceled, or deferred. The HMPC also provided notes and updates about most actions. The review of actions from the 2012 HMP is shown in Table 6.1-2. The “Status” and “Status Update Notes” columns include information and updates about each action provided by the HMPC. New actions were also included in the 2018 mitigation strategy to address certain hazards facing Charles County. The full updated list of mitigation actions for the 2018 HMP is shown in Table 6.4-1.

Table 6.1-2: **Review of 2012 HMP Mitigation Action Plan**

#	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Status	Status Update Notes
1	Acquire, elevate or floodproof structures in identified repetitive loss areas throughout Charles County.	Charles County	Flood	Emergency Services, Public Facilities, Planning and Growth Management	Ongoing	Partial completion. One home was acquired and removed from the floodplain. Others are on the repetitive flood loss list. This will continue to be an action item in the next five years.
2	Inspection of critical facilities in the 100-year floodplain conducted by a certified floodplain manager.	Charles County, Town of La Plata	Flood	Emergency Services, Public Facilities, Planning and Growth Management, Town of La Plata	Ongoing	Town of La Plata indicated this is completed. Action is ongoing for Charles County.
3	Identify roadways/bridges that frequently flood and mitigate to ensure ingress and egress.	Charles County	Flood	SHA, County Roads	Ongoing	Each Department should inventory their own. This is a continuing process due to aging roadways/bridges.
4	Address flooding that is caused by an obstructed drainage ditch that runs east to west through the center of the town.	Village of Port Tobacco	Flood	Village of Port Tobacco	Ongoing	
5	Conduct engineering inspections of fire stations and schools to assess each facility's ability to sustain damage from flood and wind events.	Charles County	Flood, Extreme Weather	Charles County, Volunteer Fire Department	Ongoing	Expertise is difficult to find, this will continue to be an initiative in the next plan.
6	Review and Update model flood ordinances once new FEMA's maps are available.	Charles County	Flood	Planning & Growth Management	Completed	Revised maps from FEMA were adopted 2013 for riverine and 2015 for coastal. Both map adoptions included associated Ordinance updates.

Table 6.1-2: **Review of 2012 HMP Mitigation Action Plan**

#	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Status	Status Update Notes
7	Ensure that NFIP requirements are being met concerning repairs, renovations, and remodeling of structures located in the regulatory floodplain.	Charles County	Flood	Planning & Growth Management	Ongoing	This is completed on a case by case process as building permits are applied for and inspections required. Note: Floodplain records are kept on each project.
8	Take steps towards joining the community rating system.	Charles County	Flood	Planning & Growth Management	Ongoing	Letter of Interest was mailed in September 2017, and county floodplain manager became a designated CRS coordinator in February 2018. Note: This is at least an 18-month process.
9	Increase awareness of homes that lie in the flood zone for prospective home buyers and residents by posting a link to the County's website that provides property-specific floodzone information.	Port Tobacco, Town of La Plata, Town of Indian Head	Flood	County and Floodplain Administrator	Ongoing	
10	Promote Tornado safety public awareness and encourage the building of safe rooms during new construction.	Charles County	Extreme Weather	Emergency Services	Ongoing	This will continue to be an on-going project to provide timely emergency preparedness information to the public.
11	Encourage proper tree management new power lines to reduce risks during high wind/severe winter weather.	Charles County	Extreme Weather, Severe Winter Storms	Emergency Services, SMECO	Ongoing	Emergency Services will continue to coordinate with Southern Maryland Electric Cooperative (SMECO) for tree management around power lines.
12	Continue to support tree-trimming to prevent limb breakage and for safeguarding nearby utility lines during severe wind and winter events.	Charles County	Extreme Weather, Severe Winter Storms	Emergency Services, SMECO	Ongoing	Emergency Services will continue to coordinate with SMECO for tree management around power lines. Also, add a goal/objective specific to SMECO burying lines.

Table 6.1-2: **Review of 2012 HMP Mitigation Action Plan**

#	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Status	Status Update Notes
13	Prepare flyer for safety strategies during severe winter weather, including driver education classes and materials.	Charles County	Severe Winter Storms	Emergency Services, County Roads	Ongoing	This will continue to be an on-going project to provide timely emergency preparedness information to the public.
14	Install uninterruptible power supplies on critical electronic equipment in County facilities to prevent outages during thunder and lightning events.	Charles County	Extreme Weather	Emergency Services, Information Technology	Ongoing	County has updated the Government Building (200 Baltimore St.) to have UPS's on servers and a new generator to ensure redundant systems for servers/email for County employees during outages. DES is currently undergoing the process of updating the aging UPS for the entire building. This project will begin in January 2018 and continue through until completion.
15	Equip all County and public gathering places with lightning detectors.	Charles County	Extreme Weather	Emergency Services, and Parks, Recreation and Tourism	Ongoing	This will continue to be a project that the County would like to fit into its budget.
16	Install surge protectors on electronic equipment in County facilities to protect equipment during thunderstorm and lightning events.	Charles County	Extreme Weather	Emergency Services, Information Technology	Ongoing	Some but not all facilities have surge protection. This will be an on-going project.

Table 6.1-2: **Review of 2012 HMP Mitigation Action Plan**

#	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Status	Status Update Notes
17	Establish heating and cooling centers for vulnerable populations and link them to outreach projects that encourage at-risk populations to use the facilities.	Charles County	Temperature Extremes	Emergency Services	Ongoing	Heating and cooling centers are available to the public. An updated MOU between Emergency Services, Social Services, Sheriff's Office, Health Department, and the Lifestyles, Inc. has been signed to ensure shelter for vulnerable populations during temperature extremes. However, this will be an on-going project of educating the public to use these facilities when needed.
18	Develop public awareness campaign regarding extreme temperatures and how they affect residents.	Charles County	Temperature Extremes	Emergency Services	Ongoing	This will continue to be an on-going project to provide timely emergency preparedness information to the public.
19	Purchase equipment necessary to sustain hazardous materials for emergency response teams.	Charles County	Nuclear Events, Environmental Hazards	Tactical Response Team (TRT), Fire Companies	Ongoing	Sustainment of the TRT for hazmat response is a continual project. Personnel, training, and response equipment occur on a monthly basis and will continue during the next five years.
20	Initiate a new commodity flow study.	Charles County	Environmental Hazards	Emergency Services	Ongoing	Funding and personnel continue to be an issue to complete a Commodity Flow Study for Charles County. This is an on-going project.

Table 6.1-2: **Review of 2012 HMP Mitigation Action Plan**

#	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Status	Status Update Notes
21	Encourage immunization against diseases that can be easily communicable among residents of Charles County.	Charles County	Public Health Emergency	Emergency Services, Health Department	Ongoing	Changed lead agency to just Health Department.
22	Establish areas where vaccines and other medication could be dispensed during a public health emergency.	Charles County	Public Health Emergency	Emergency Services	Ongoing	Changed lead agency to Health Department. Four school based sites have been identified and certified by the State Strategic National Stockpile (SNS) Coordinator.
23	Upgrade water suppression system.	Charles County	All Hazards	Public Works, Planning and Growth Management	Ongoing	
24	Incorporate the HMP into Charles County's comprehensive plan for 2018.	Charles County	All Hazards	Planning & Growth Management	Ongoing	The Plan was included in the previous edition of the comprehensive plan and will continue to be included in future editions.
25	Evaluate Tier 2 facilities on an annual basis.	Charles County	All Hazards	Tactical Response Team (TRT)	Ongoing	
26	Implement a rural water supply plan.	Charles County	All Hazards	Volunteer Fire Departments	Deferred	
27	Obtain grant funding for generators for critical facilities.	Charles County	All Hazards	Emergency Services	Ongoing	Several fire departments were interested in submitting HMGP grants for generators, but did not complete the applications to submit to MEMA.
28	Update 1997 Emergency Services Plan to include the towns of Indian Head and La Plata in the update.	Charles County	All Hazards	Emergency Services	Completed	

Table 6.1-2: **Review of 2012 HMP Mitigation Action Plan**

#	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Status	Status Update Notes
29	During new construction or upgrades/retrofits to schools and emergency shelters, funding should be obtained to provide these facilities with emergency generators and intercoms.	Charles County	All Hazards	Emergency Services, Public Schools	Ongoing	As schools are proposed to be built or upgraded the state enacted legislation under the Public School Construction Program to analyze each school for emergency shelter capabilities.
30	Review RF values annual for all hazards identified in the 2012 HMP Update.	Charles County	All Hazards	Emergency Services	Canceled	
31	Work with the Town of Indian Head and Lackey High School to determine ways to provide alternative access during a hazard event.	Charles County, Town of Indian Head	All Hazards	Town of Indian Head, Emergency Services	Ongoing	Town of Indian Head indicated that this is still relevant.
32	Send news releases to local newspapers, radio, and TV stations with pre-disaster information while attempting to reach all areas of Charles County.	Charles County	All Hazards	Emergency Services, Town of Indian Head, Town of La Plata	Ongoing	This will continue to be an on-going project to provide timely emergency preparedness information to the public. Town of Indian Head noted that it uses Facebook, the town website, town entrance marquee, CNS requests, community affairs notifications to HOAs, and town email blasts.
33	Develop an annual preparedness and mitigation newsletter.	Charles County	All Hazards	Emergency Services	Canceled	This action will be rolled up into the emergency preparedness information to the public action.

Table 6.1-2: **Review of 2012 HMP Mitigation Action Plan**

#	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Status	Status Update Notes
34	Continue to introduce environmental education programs in schools, park and recreation department, conservation associations, and youth organizations such as boy scouts/girl scouts, campfire girls, and summer camps.	Charles County, Town of Indian Head, Town of La Plata	All Hazards	Emergency Services, Town of Indian Head, Town of La Plata	Ongoing	This will continue to be an on-going project to provide timely emergency preparedness information to the public. Since 2011 DES has performed multiple emergency preparedness presentations throughout the County to youth groups, senior groups, and open groups such as at the libraries. Town of Indian Head noted that it has a planned tree planting project with Indian Head Elementary School for Earth Day 2018 on the Village Green.
35	Ensure access to special needs populations is provided and prohibit future development in high hazard areas and encourage low density development and open space areas.	Charles County	All Hazards	Emergency Services, Planning and Growth Management	Ongoing	This action was split into three separate actions for the 2018 HMP Update.
36	Continue to work with the Red Cross to develop disaster preparedness plan and disaster kits. Coordinate efforts with agencies such as emergency services, police and fire departments.	Charles County	All Hazards	Emergency Services	Completed	The Red Cross is no longer a lead agency for sheltering and is a minor operator in the County's emergency plans. All emergency plans actively coordinate with police and fire.

Table 6.1-2: **Review of 2012 HMP Mitigation Action Plan**

#	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Status	Status Update Notes
37	Establish schools as repositories for information on local hazard mitigation and to serve as a venue for workshops, resource materials, and convenient meeting place for interest groups such as relators, lenders, etc.	Charles County	All Hazards	Emergency Services, Planning and Growth Management	Canceled	It was determined that libraries are more appropriate to hold information on hazard mitigation. Schools will not be repositories for this information.
38	Areas of development such as Quailwood, Clarks Run, Kings Grant, Indian Head, Bryans Road, Waldorf, White Plains, and other populations centers should be identified for the installation of early warning devices.	Charles County, Town of La Plata, Town of Indian Head, Village of Port Tobacco	All Hazards	Emergency Services, Planning and Growth Management, Town of La Plata, Town of Indian Head, Village of Port Tobacco	Canceled	It was determined that outdoor warning sirens are not an efficient means to notify everyone of an impending tornado. The County has decided to push funding to technology and an automated mass notification system for public alert and warning instead of utilizing outdoor sirens that don't notify a significant portion of the County. Town of Indian Head noted that the local Indian Head Volunteer Fire Department has a siren for emergencies (heard throughout town limits with some limited sound range). Naval support facility also has a giant voice system that can be activated in emergency situations.
39	Review Capital Improvement Plans to ensure that programmed infrastructure improvements are not in high hazard areas.	Charles County, Town of La Plata, Town of Indian Head, Village of Port Tobacco	All Hazards	Emergency Services, Planning and Growth Management, Town of La Plata, Town of Indian Head, Village of Port Tobacco	Ongoing	Town of Indian Head noted that this is relevant, and the Town supports County's floodplain management program.

Table 6.1-2: **Review of 2012 HMP Mitigation Action Plan**

#	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Status	Status Update Notes
40	Provide engineering services to reduce erosion at the Potomac and Port Tobacco Rivers.	Charles County	All Hazards	Emergency Services, Conservation	Deferred	This action has been re-directed to actions related to cultural and historic resources.
41	Introduce language in the comprehensive plan to plan for development while considering hazards and their impacts in highly developed areas.	Charles County, Town of La Plata, Town of Indian Head, Village of Port Tobacco	All Hazards	Emergency Services, Planning and Growth Management, Town of La Plata, Town of Indian Head, Village of Port Tobacco	Ongoing	Town of Indian Head noted that this is ongoing and it is currently updating its Comprehensive Plan. Town of La Plata noted that this will be addressed in its 2018 HMP Update.
42	Inform the public about defensible space and how to reduce their risk to fire.	Charles County	All Hazards	Emergency Services, Volunteer Fire Departments	Ongoing	This will continue to be an on-going project to provide timely emergency preparedness information to the public.
43	Review regulations to ensure adequate zoning regulations are in place to reduce future development in high-hazard areas and introduce new language to this effect in their zoning ordinances.	Charles County, Town of La Plata, Town of Indian Head	All Hazards	Planning and Growth Management, Town of La Plata, Town of Indian Head	Ongoing	Town of Indian Head noted that this is relevant, and the Town supports County's floodplain management program.
44	Perform outreach activities to information residents of their vulnerability to hazards and how to mitigate. This may include flyers on keeping drain ditches clear, participation in the NFIP and safety tips.	Village of Port Tobacco	All Hazards	Village of Port Tobacco	Ongoing	
45	La Plata to conduct tests of its early warning/sirens. Conduct tests bi-annually (early May and December)	Town of La Plata	All Hazards	Town of La Plata	Ongoing	
46	Obtain additional wildfire data to provide a more detailed	Charles County	Wildfire	Emergency Services	Deferred	

Table 6.1-2: Review of 2012 HMP Mitigation Action Plan						
#	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Status	Status Update Notes
	assessment of loss and potential loss information for wildfires.					
47	Identify high threat erosion areas throughout the County and conduct and analyze scenarios using the bank erosion hazard index (BEHI).	Charles County	Earth Disturbance	Emergency Services	Deferred	Erosion is a low threat hazard. Therefore, the County has not devoted time to a more detailed assessment.

6.1.3 Mitigation Successes

Since the 2012 HMP Update, Charles County and its jurisdictions completed several projects and had several mitigation successes, including:

- Acquiring and removing one home from the SFHA.
- Adopted new ordinances after receiving revised FIRMs from FEMA in 2013 and 2015.
- Submitting a letter of interest for the CRS Program in September 2017.
- County floodplain manager became a designated CRS Coordinator in February 2018.
- Updating the Government Building (200 Baltimore Street) to have UPS's on servers and a new generator to ensure redundant systems for servers/email for County employees during outages.
- Performing multiple emergency preparedness presentations throughout the County to youth groups, senior groups, and open groups, such as at libraries.

6.2 Mitigation Goals and Objectives

Based on the results of the review of current conditions and the mitigation goals and objectives established in 2012, the HMPC developed an additional goal and six new objectives for inclusion in the 2018 HMP. This brings the total number of goals and objectives to 9 and 37 respectively. Table 6.2-1 details the mitigation goals and objectives that support the 2018 mitigation strategy. The ninth goal is new for the 2018 HMP, and the additional objectives are highlighted in green below.

Table 6.2-1:	**2018 HMP Goals and Objectives**
Goal 1	Protect existing natural resources and preserve environmentally sensitive areas where hazard potential is high.
Objective 1A	Protect existing natural resources and open space, including parks and wetlands, within the floodplains.
Objective 1B	Restore degraded natural resources and open space to improve their flood control function.
Objective 1C	Preserve areas where natural hazard potential is high such as steeply sloping areas, sinkhole areas.
Goal 2	Promote disaster-resistant future development.
Objective 2A	Minimize future damage due to flooding by promoting resistant construction, retrofitting techniques and in the rural areas by erosion/sedimentation control practices.
Objective 2B	Regulate construction and development in the County to minimize increases in impervious surfaces to reduce runoff and flood risk.
Objective 2C	Ensure that new construction is resistant to natural hazards by adhering to floodplain regulations, building codes, and land use and development regulations.
Goal 3	Attempt to reduce the current and future risk of flood damage.
Objective 3A	Continue to participate in the National Flood Insurance Program.
Objective 3B	Reduce the vulnerability of County roads and other infrastructure to the impacts of flooding.
Objective 3C	Ensure regulations reduce the amount of future development in identified flood hazard areas.

Table 6.2-1:	2018 HMP Goals and Objectives
Objective 3D	Evaluate and update existing floodplain ordinances to meet or exceed the NFIP standards and evaluate impacts of sea level rise.
Objective 3E	Address stormwater issues in existing communities.
Goal 4	Reduce the potential impacts of natural and man-made disaster on public and private property.
Objective 4A	Address rural fire protection measures.
Objective 4B	Ensure adequate public safety infrastructure.
Objective 4C	Address problems regarding adequate water supply.
Objective 4D	Reduce the vulnerability of life, property, and infrastructure within the County to High Hazard Dams.
Objective 4E	Minimize the impact of winter weather on life, property, buildings, critical facilities, and infrastructure.
Objective 4F	Reduce vulnerability to environmental hazards by providing enhanced trainings, equipment, and plans for emergency response and mitigation.
Objective 4G	Continue to monitor low risk hazards based on Risk Factor (RF) Methodology and modify the plan if risk should change before the plan needs to be updated.
Objective 4H	Seek opportunities to protect critical communications infrastructure, such as by upgrading or burying powerlines where feasible.
Goal 5	Protect public health, safety, and welfare by increasing public awareness of existing hazards (those identified in the 2018 HMP Update) and by fostering both individual and public responsibility in mitigation the potential impacts and risks of those hazards.
Objective 5A	Develop and distribute public awareness materials about natural hazard risks, preparedness, and mitigation.
Objective 5B	Target owners of properties within identified hazard areas for additional outreach regarding mitigation and disaster preparedness.
Objective 5C	Coordinate with organizations that provide services to identified special populations.
Goal 6	Identify high risk hazard areas and ultimately areas where hazards can be mitigated.
Objective 6A	Direct Tier II facilities development away from high risk infrastructure such as schools and community based organizations.
Objective 6B	Collect all necessary data and develop commodity study.
Goal 7	Provide adequate care during hazard events to prevent or reduce damage to lives and property.
Objective 7A	Ensure evacuation information is readily available throughout the County.
Objective 7B	Ensure evacuation needs for special populations are met.
Objective 7C	Reduce impact of an outbreak by providing information and care regarding infectious diseases such as influenza.
Goal 8	Improve communications, planning, and coordination throughout the County, including among county departments, jurisdictions, and both public and private stakeholders
Objective 8A	Ensure all areas including rural portions of the County are in communication with the County at all times.
Objective 8B	Provide information to critical infrastructure, schools, and community based organizations as soon as possible from the EOC.
Objective 8C	Provide adequate, safe, and efficient evacuation routes and shelters during hazard events.
Objective 8D	Implement effective emergency warning systems throughout the County.

Table 6.2-1:	2018 HMP Goals and Objectives
Objective 8E	Ensure that local officials are well trained regarding natural hazard and appropriate prevention and mitigation activities and improve communications between the public and emergency management services.
Objective 8F	Promote partnerships between various County departments and communities to continue to develop a County-wide approach to identifying and implementing mitigation actions.
Objective 8G	Seek opportunities to integrate hazard mitigation efforts with other planning initiatives throughout the County.
Goal 9	Protect and preserve the County's cultural, historic, and archaeological resources through mitigation planning and action.
Objective 9A	Identify high priority historic and cultural resources throughout the County.
Objective 9B	Implement policies and procedures to protect and preserve high priority historic, cultural, and archaeological resources.
Objective 9B	Educate the property owners, the public, and other stakeholders about mitigation techniques for historic properties.

6.3 Identification and Analysis of Mitigation Techniques

The mitigation strategy in the updated HMP should include analysis of a comprehensive range of specific techniques or actions. FEMA, through the March 2013 Local Mitigation Handbook, identifies four categories of hazard mitigation techniques.

- **Local plans and regulations**: Government authorities, policies, or codes that influence the way land and buildings are developed and built. Examples include, but are not limited to: comprehensive plans, subdivision regulations, building codes and enforcement, and NFIP and CRS.
- **Structure and infrastructure**: Modifying existing structures and infrastructure or constructing new structures to reduce hazard vulnerability. Examples include, but are not limited to: acquisition and elevation of structures in flood prone areas, utility undergrounding, structural retrofits, floodwalls and retaining walls, detention and retention structures, and culverts.
- **Natural systems protection**: Actions that minimize damage and losses and preserve or restore the functions of natural systems. Examples include, but are not limited to: sediment and erosion control, stream corridor restoration, forest management, conservation easements, and wetland restoration and preservation.
- **Education and awareness**: Actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate the hazards, and may also include participation in national programs. Examples include, but are not limited to: radio or television spots, websites with maps and information, provide information and training, NFIP outreach, StormReady, and Firewise Communities.

Table 6.3-1 provides a matrix identifying the mitigation techniques used for the hazards identified in the risk assessment. The specific actions associated with these techniques are included in Table 6.4-1.

Table 6.3-1: **Mitigation Techniques Used for All Hazards in Charles County**

HAZARD	MITIGATION TECHNIQUE			
(in order of RF Ranking)	Plans and Regulations	Structure and Infrastructure	Natural Systems Protection	Education and Awareness
Extreme Weather (N)	X	X	X	X
Temperature Extremes (N)	X	X		X
Flood (N)	X	X		X
Public Health Emergency (H)	X	X		X
Hurricane, Tropical Storm, and Nor'easter (N)	X	X		X
Utility Interruption (H)	X	X	X	X
Severe Winter Storms (N)	X	X	X	X
Environmental Hazards (H)	X	X		X
Transportation Accidents (H)	X	X		X
Civil Disturbance and Criminal Activity (H)	X	X		X
Building and Structure Collapse (H)	X	X		X
Dam Failure (H)	X	X		X
Earth Disturbance (N)	X	X	X	X
Drought (N)	X	X		X
Erosion (N)	X	X	X	X
Nuclear Events (H)	X	X		X
Wildfire (N)	X	X		X

6.4 Mitigation Action Plan

The HMPC attended the Mitigation Solutions Workshop on December 13, 2017 to develop a framework for the Mitigation Action Plan. As a part of the Workshop, the attendees reviewed current risk assessment for the County and their municipalities and the four new Mitigation Techniques identified by FEMA. The attendees were then provided the Mitigation Action Progress Report to review the previous actions identified for their municipality in 2012 to determine if these were still relevant to their current conditions, as well as the Mitigation Action Worksheet to identify new actions to address risks in their community. Meeting Minutes from these meetings and completed forms are included in Appendix C.

The final list of 70 mitigation actions in Table 6.4-1 is made up of actions developed by the HMPC along with actions developed by municipalities and other stakeholders at the Mitigation Solutions Meeting. In addition, the list includes 2012 actions and projects that were identified as ongoing or not yet complete. At least one mitigation action was established for each hazard in Charles County identified in the Risk Assessment. More than one action is identified for several hazards. Every participating jurisdiction has at least one mitigation action. Each mitigation action is intended to address one or more of the goals and objectives identified in Section 6.2.

Mitigation actions were evaluated using the Multi-Objective Mitigation Action Prioritization criteria rather than STAPLEE for the 2018 Update, as this approach is more streamlined and focuses more on criteria related to the feasibility and utility of each action. The criteria are as follows:

- **Effectiveness (weight: 20% of score):** The extent to which an action reduces the vulnerability of people and property.
- **Efficiency (weight: 30% of score):** The extent to which time, effort, and cost is well used as a means of reducing vulnerability.
- **Multi-Hazard Mitigation (weight: 20% of score):** The action reduces vulnerability for more than one hazard.
- **High Risk Hazard (weight: 15% of score):** The action reduces vulnerability for people and property from a hazard(s) identified as high risk.
- **Critical Communications/Critical Infrastructure (weight: 15% of score):** The action pertains to the maintenance of critical functions and structures such as transportation, supply chain management, data circuits, etc.

Scores of 1, 2, or 3 were assigned for each multi-objective mitigation action prioritization criterion where 1 is a low score and 3 is a high score. Actions were prioritized using the cumulative score assigned to each. Each mitigation action was given a priority ranking (Low, Medium, and High) based on the following:

- High Priority (highlighted red): 2.5 – 3.0
- Medium Priority (highlighted yellow): 1.9 – 2.49
- Low Priority (highlighted green): 1.0 – 1.89

The Mitigation Action Plan, detailed in Table 6.4-1, includes the details of each identified action, the municipality that the action pertains to, the mitigation technique the action pertains to, the hazard the action addresses, the department or agency responsible for implementing the agency, the schedule that the action will be implemented in, potential funding sources for implementing the action, and the priority score derived using the Multi-Objective Mitigation Action Prioritization criteria. This table sorts each action by hazard. New actions for 2018 are highlighted in Green. The Multi-Objective Mitigation Action Prioritization criteria for each action are included in Table 6.4-2, and new actions for 2018 are also highlighted in this table.

Table 6.4-1: **Charles County 2018 Mitigation Action Plan (Sorted by Hazard)**

Number	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Category	Potential Funding	Implementation Schedule	Priority Score
1	Install uninterruptible power supplies on critical electronic equipment in County facilities to prevent outages during thunder and lightning events.	Charles County	Extreme Weather	Emergency Services, Information Technology	Structure and Infrastructure	County	3-Years	2.8
2	Encourage proper tree management for new power lines to reduce risks during high wind/severe winter weather.	Charles County	Extreme Weather, Severe Winter Storms	Emergency Services, SMECO	Natural Systems Protection	County, SMECO	Ongoing	2.7
3	Continue to support tree-trimming to prevent limb breakage and for safeguarding nearby utility lines during severe wind and winter events.	Charles County	Extreme Weather, Severe Winter Storms	Emergency Services, SMECO	Natural Systems Protection	County, SMECO	Ongoing	2.7
4	Install surge protectors on electronic equipment in County facilities to protect equipment during thunderstorm and lightning events.	Charles County	Extreme Weather	Emergency Services, Information Technology	Structure and Infrastructure	County	Ongoing	2.6
5	Conduct engineering inspections of fire stations and schools to assess each facility’s ability to sustain damage from flood and wind events.	Charles County	Flood, Extreme Weather	Charles County, Volunteer Fire Department	Structure and Infrastructure	County	5-Years	2.5
6	Protect County buildings from hail damage by installing hail guards on roof-mounted HVAC equipment and installing hail-resistant roofing and siding when feasible on newly constructed facilities	Charles County	Extreme Weather	Charles County	Structure and Infrastructure	County, FEMA	5-Years	2.5
7	Promote Tornado safety public awareness and encourage the building of safe rooms during new construction.	Charles County	Extreme Weather	Emergency Services	Plans and Regulations, Education and Awareness	County	Ongoing	2.15
8	Equip all County and public gathering places with lightning detectors.	Charles County	Extreme Weather	Emergency Services, Parks, Recreation and Tourism	Structure and Infrastructure	County	5-Years	1.8

Table 6.4-1: **Charles County 2018 Mitigation Action Plan (Sorted by Hazard)**

Number	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Category	Potential Funding	Implementation Schedule	Priority Score
9	Establish heating and cooling centers for vulnerable populations and link them to outreach projects that encourage at-risk populations to use the facilities.	Charles County	Temperature Extremes	Emergency Services	Structure and Infrastructure, Education and Awareness	County	Ongoing	1.8
10	Develop public awareness campaign regarding extreme temperatures and how they affect residents.	Charles County	Temperature Extremes	Emergency Services	Education and Awareness	County	Ongoing	1.8
11	Continue to acquire, elevate or floodproof structures in identified repetitive loss areas throughout Charles County.	Charles County	Flood	Emergency Services, Public Facilities, Planning and Growth Management	Structure and Infrastructure	HMGP, PDM, FMA, CDBG-DR	Ongoing	2.35
12	Ensure that NFIP requirements are being met concerning repairs, renovations, and remodeling of structures located in the regulatory floodplain.	Charles County	Flood	Planning & Growth Management	Plans and Regulations, Structure and Infrastructure	County	Ongoing	2.3
13	Address flooding that is caused by an obstructed drainage ditch that runs east to west through the center of the town.	Village of Port Tobacco	Flood	Village of Port Tobacco	Plans and Regulations, Structure and Infrastructure	County	3-Years	2.15
14	Take steps towards joining the community rating system.	Charles County	Flood	Planning & Growth Management	Plans and Regulations, Education and Awareness	County	3-Years	2.15
15	Implement stormwater management and drainage improvements in flood-prone historic districts.	Charles County, Town of La Plata, Town of Indian Head, Village of Port Tobacco	Flood	Planning and Growth Management	Plans and Regulations, Structure and Infrastructure	County, MDE, FEMA	5-Years	2.15

Table 6.4-1: **Charles County 2018 Mitigation Action Plan (Sorted by Hazard)**

Number	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Category	Potential Funding	Implementation Schedule	Priority Score
16	Inspection of critical facilities in the 100-year floodplain conducted by a certified floodplain manager.	Charles County, Town of La Plata	Flood	Emergency Services, Public Facilities, Planning and Growth Management, Town of La Plata	Structure and Infrastructure	County	5-Years	2.1
17	Identify roadways/bridges that frequently flood and mitigate to ensure ingress and egress.	Charles County	Flood	SHA, County Roads	Structure and Infrastructure	County	5-Years	2.1
18	Increase awareness of homes that lie in the flood zone for prospective home buyers and residents by posting a link to the County's website that provides property-specific flood zone information.	Port Tobacco, Town of La Plata, Town of Indian Head	Flood	County and Floodplain Administrator	Education and Awareness	County	3-Years	1.8
19	Encourage immunization against diseases that can be easily communicable among residents of Charles County.	Charles County	Public Health Emergency	Health Department	Education and Awareness	Federal	Ongoing	2.1
20	Establish areas where vaccines and other medications could be dispensed during a public health emergency.	Charles County	Public Health Emergency	Health Department	Plans and Regulations	Federal	Ongoing	1.8
21	Incorporate inspection and management of hazardous trees into other maintenance processes.	Charles County	Utility Interruption	Public Works	Plans and Regulations, Natural Systems Protection	County	3-Years	2.8
22	Work with utility providers to ensure regular maintenance and upkeep of power lines and other utilities.	Charles County	Utility Interruption	Emergency Services, SMECO	Structure and Infrastructure	County, SMECO	5-Years	2.8
23	Identify opportunities to upgrade or bury power lines.	Charles County	Utility Interruption	Emergency Services, SMECO	Structure and Infrastructure	County, SMECO	5-Years	2.4

Table 6.4-1: **Charles County 2018 Mitigation Action Plan (Sorted by Hazard)**

Number	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Category	Potential Funding	Implementation Schedule	Priority Score
24	Prepare flyer for safety strategies during severe winter weather, including driver education classes and materials.	Charles County	Severe Winter Storms	Emergency Services, County Roads	Education and Awareness	County	3-Years	1.95
25	Review existing land use and development patterns near pipelines.	Charles County, Town of La Plata, Town of Indian Head, Village of Port Tobacco	Environmental Hazards	Planning and Growth Management, Emergency Services	Plans and Regulations	County	3-Years	2.1
26	Review pathways for potential gas or hazardous liquid migration in the event of a pipeline release and encourage land use planning and zoning controls to decrease population density in high risk areas.	Charles County	Environmental Hazards	Planning and Growth Management, Emergency Services	Plans and Regulations	County	5-Years	2.1
27	Initiate a new commodity flow study.	Charles County	Environmental Hazards	Emergency Services	Plans and Regulations	County, PHMSA	5-Years	1.95
28	Evaluate Tier 2 facilities on an annual basis.	Charles County	Environmental Hazards	Tactical Response Team (TRT)	Plans and Regulations	County	Ongoing	1.8
29	Purchase equipment necessary to sustain hazardous materials for emergency response teams.	Charles County	Environmental Hazards, Nuclear Events	Tactical Response Team (TRT), Fire Companies	Structure and Infrastructure	County, FEMA, MEMA	5-Years	1.5
30	Plan for and maintain adequate road and debris clearing capabilities.	Charles County	Transportation Accident	Public Works	Plans and Regulations	County, MDOT, USDOT	Ongoing	2.15
31	Implement traffic safety improvements at high-crash intersections and roadway segments.	Charles County, Town of La Plata, Town of Indian Head, Village of Port Tobacco	Transportation Accident	Public Works	Plans and Regulations, Structure and Infrastructure	County, MDOT, USDOT	Ongoing	2

Table 6.4-1: **Charles County 2018 Mitigation Action Plan (Sorted by Hazard)**

Number	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Category	Potential Funding	Implementation Schedule	Priority Score
32	Develop Aircraft Emergency Disaster Plan.	Charles County	Transportation Accident	Emergency Services	Plans and Regulations	County, MDOT, USDOT	5-Years	1.65
33	Continue Crime Solvers Program.	Charles County	Civil Disturbance and Criminal Activity	Sheriff's Office	Plans and Regulations, Education and Awareness	County	Ongoing	1.95
34	Continue offering free home and business security surveys.	Charles County	Civil Disturbance and Criminal Activity	Sheriff's Office	Plans and Regulations, Education and Awareness	County	Ongoing	1.95
35	Continue publishing “Watch Works” newsletter.	Charles County	Civil Disturbance and Criminal Activity	Sheriff's Office	Plans and Regulations, Education and Awareness	County	Ongoing	1.95
36	Encourage Crime Prevention Through Environmental Design (CPTED) principles.	Charles County	Civil Disturbance and Criminal Activity	Sheriff's Office, Planning and Growth Management	Plans and Regulations, Education and Awareness	County	Ongoing	1.8
37	Retrofit or rebuild high-priority structurally deficient bridges.	Charles County	Building and Structure Collapse	Public Works	Structure and Infrastructure	County, MDOT, USDOT	Ongoing	2.25
38	Review existing conditions of bridges to determine their susceptibility to collapse.	Charles County	Building and Structure Collapse	Public Works	Structure and Infrastructure	County, MDOT, USDOT	5-Years	2.15
39	Retrofit public buildings and critical facilities to withstand snow loads and prevent roof collapse.	Charles County	Building and Structure Collapse	Emergency Services	Structure and Infrastructure	County, FEMA, MEMA	5-Years	1.85

Table 6.4-1: **Charles County 2018 Mitigation Action Plan (Sorted by Hazard)**

Number	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Category	Potential Funding	Implementation Schedule	Priority Score
40	Continue inspection, maintenance, and enforcement program to help ensure continued structural integrity of dams.	Charles County	Dam Failure	Emergency Services	Plans and Regulations, Structure and Infrastructure	County	Ongoing	2.25
41	Regulate development near steep slopes.	Charles County, Town of La Plata, Town of Indian Head, Village of Port Tobacco	Earth Disturbance	Planning and Growth Management	Plans and Regulations	County	Ongoing	2.15
42	Apply soil stabilization measures on steep, publicly-owned slopes.	Charles County	Earth Disturbance	Planning and Growth Management	Plans and Regulations, Natural Systems Protection	County, MDE	5-Years	1.85
43	Encourage structural designs that can resist loading associated with subsidence.	Charles County	Earth Disturbance	Planning and Growth Management	Plans and Regulations, Structure and Infrastructure	County	Ongoing	1.65
44	Identify ways to reduce vulnerability of historic properties to coastal erosion, particularly along the Potomac and Port Tobacco Rivers.	Charles County	Earth Disturbance	Emergency Services, Planning and Growth Management	Natural Systems Protection	County, MHT	5-Years	1.65
45	Develop database to track landslide events.	Charles County	Earth Disturbance	Emergency Services, Soil Conservation District	Plans and Regulations	County	5-Years	1.3

Table 6.4-1: **Charles County 2018 Mitigation Action Plan (Sorted by Hazard)**

Number	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Category	Potential Funding	Implementation Schedule	Priority Score
46	Monitor groundwater levels and areas where natural resources are removed underground.	Charles County	Earth Disturbance	Planning and Growth Management, Soil Conservation District	Plans and Regulations, Natural Systems Protection	County, MDE	Ongoing	1.3
47	Inform the public about defensible space and how to reduce their risk to fire.	Charles County	Wildfire	Emergency Services, Volunteer Fire Departments	Education and Awareness	County, FireWise, FEMA	Ongoing	1.3
48	Review Capital Improvement Plans to ensure that programmed infrastructure improvements are not in high hazard areas.	Charles County, Town of La Plata, Town of Indian Head, Village of Port Tobacco	All Hazards	Emergency Services, Planning and Growth Management, Town of La Plata, Town of Indian Head, Village of Port Tobacco	Plans and Regulations	County, Municipal	Ongoing	2.8
49	Continue to conduct tests of its early warning/sirens bi-annually (early May and December).	Town of La Plata	All Hazards	Town of La Plata	Structure and Infrastructure, Education and Awareness	Municipal	Ongoing	2.8
50	Obtain grant funding for generators for critical facilities.	Charles County	All Hazards	Emergency Services	Plans and Regulations	HMGP, PDM	5-Years	2.7
51	During new construction or upgrades/retrofits to schools and emergency shelters, funding should be obtained to provide these facilities with emergency generators and intercoms.	Charles County	All Hazards	Emergency Services, Public Schools	Structure and Infrastructure	County, State	Ongoing	2.7

Table 6.4-1: **Charles County 2018 Mitigation Action Plan (Sorted by Hazard)**

Number	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Category	Potential Funding	Implementation Schedule	Priority Score
52	Review regulations to ensure adequate zoning regulations are in place to reduce future development in high-hazard areas and introduce new language to this effect in their zoning ordinances.	Charles County, Town of La Plata, Town of Indian Head	All Hazards	Planning and Growth Management, Town of La Plata, Town of Indian Head	Plans and Regulations	County, Municipal	5-Years	2.65
53	Continue incorporating the HMP into future updates of the Charles County's Comprehensive Plan.	Charles County	All Hazards	Planning & Growth Management	Plans and Regulations	County	Ongoing	2.5
54	Introduce language in the comprehensive plan to plan for development while considering hazards and their impacts in highly developed areas.	Charles County, Town of La Plata, Town of Indian Head, Village of Port Tobacco	All Hazards	Emergency Services, Planning and Growth Management, Town of La Plata, Town of Indian Head, Village of Port Tobacco	Plans and Regulations	County	5-Years	2.5
55	Work with the Town of Indian Head and Lackey High School to determine ways to provide alternative access during a hazard event.	Charles County, Town of Indian Head	All Hazards	Town of Indian Head, Emergency Services	Education and Awareness	County, Municipal	3-Years	2.45
56	Include Historic Properties in the County's Debris Management Plan.	Charles County	All Hazards	Planning and Growth Management, Emergency Services, Public Works	Plans and Regulations	County	3-Years	2.4
57	Send news releases to local newspapers, radio, and TV stations with pre-disaster information while attempting to reach all areas of Charles County.	Charles County	All Hazards	Emergency Services, Town of Indian Head, Town of La Plata	Education and Awareness	County	Ongoing	2.35

Table 6.4-1: **Charles County 2018 Mitigation Action Plan (Sorted by Hazard)**

Number	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Category	Potential Funding	Implementation Schedule	Priority Score
58	Continue to introduce environmental education programs in schools, park and recreation department, conservation associations, and youth organizations such as boy scouts/girl scouts, campfire girls, and summer camps.	Charles County, Town of Indian Head, Town of La Plata	All Hazards	Emergency Services, Town of Indian Head, Town of La Plata	Education and Awareness	County	Ongoing	2.35
59	Ensure access to special needs populations is provided.	Charles County	All Hazards	Emergency Services, Planning and Growth Management	Plans and Regulations	County, Municipal	Ongoing	2.35
60	Conduct Archaeological Survey of High Priority Sites in High Hazard Areas.	Charles County	All Hazards	Planning and Growth Management	Plans and Regulations	County, MHT	5-Years	2.35
61	Create an Expedited Review Process for historic properties to be utilized post-incident	Charles County	All Hazards	Planning and Growth Management	Plans and Regulations, Structure and Infrastructure	County	5-Years	2.35
62	Establish a Demolition Delay Process for historic properties to be utilized post-incident.	Charles County	All Hazards	Planning and Growth Management, Emergency Services, Public Works	Plans and Regulations, Structure and Infrastructure	County	5-Years	2.35
63	Develop disaster plans for historic sites and resources owned by Charles County.	Charles County	All Hazards	Planning and Growth Management, Emergency Services	Plans and Regulations	County, MHT, FEMA	5-Years	2.35
64	Conduct targeted outreach to historic property owners about mitigation techniques and recovery.	Charles County	All Hazards	Emergency Services, Planning and Growth Management	Education and Awareness	County, MHT	3-Years	2.35

Table 6.4-1: **Charles County 2018 Mitigation Action Plan (Sorted by Hazard)**

Number	Action	Community	Hazard(s) Addressed	Lead Agency/ Department	Category	Potential Funding	Implementation Schedule	Priority Score
65	Upgrade water suppression system	Charles County	All Hazards	Public Works, Planning and Growth Management	Structure and Infrastructure	County, FEMA	5-Years	2.2
66	Perform outreach activities to information residents of their vulnerability to hazards and how to mitigate. This may include newsletters, flyers on keeping drain ditches clear, participation in the NFIP, and safety tips.	Village of Port Tobacco	All Hazards	Village of Port Tobacco	Education and Awareness	Municipal	Ongoing	2.2
67	Create an Archaeological Context for Charles County based on a literature review of academic and historical works, and on information found in the archaeological data at the Maryland Historical Trust.	Charles County	All Hazards	Planning and Growth Management	Plans and Regulations	County, MHT	3-Years	1.9
68	Prioritize list of critical facilities that are vulnerable to natural and human-made hazards and develop potential mitigation solutions for high-priority critical facilities to reduce vulnerability.	Charles County, Town of Indian Head, Town of La Plata	All Hazards	Planning and Growth Management, Emergency Services	Plans and Regulations, Structure and Infrastructure	County, FEMA	5-Years	2.6
69	Prohibit future development in high hazard areas.	Charles County	All Hazards	Planning and Growth Management	Plans and Regulations	County, Municipal	Ongoing	2.35
70	Encourage low density development and open space areas.	Charles County	All Hazards	Planning and Growth Management	Plans and Regulations	County, Municipal	Ongoing	2.15

Actions highlighted in green are new for the 2018 HMP Update.

Table 6.4-2: Mitigation Action Prioritization							
MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA Low = 0-1.8 Medium = 1.9-2.4 High = 2.5-3					
#	Action	Effectiveness	Efficiency	Multi-Hazard Mitigation	Addresses High Risk Hazard	Addresses Critical Communications/Critical Infrastructure	Total Score
1	Install uninterruptible power supplies on critical electronic equipment in County facilities to prevent outages during thunder and lightning events.	3	3	2	3	3	2.8
21	Incorporate inspection and management of hazardous trees into other maintenance processes.	2	3	3	3	3	2.8
22	Work with utility providers to ensure regular maintenance and upkeep of power lines and other utilities.	2	3	3	3	3	2.8
48	Review Capital Improvement Plans to ensure that programmed infrastructure improvements are not in high hazard areas.	2	3	3	3	3	2.8
49	Continue to conduct tests of its early warning/sirens bi-annually (early May and December).	2	3	3	3	3	2.8
2	Encourage proper tree management for new power lines to reduce risks during high wind/severe winter weather.	3	2	3	3	3	2.7
3	Continue to support tree-trimming to prevent limb breakage and for safeguarding nearby utility lines during severe wind and winter events.	3	2	3	3	3	2.7
50	Obtain grant funding for generators for critical facilities.	3	2	3	3	3	2.7
51	During new construction or upgrades/retrofits to schools and emergency shelters, funding should be obtained to provide these facilities with emergency generators and intercoms.	3	2	3	3	3	2.7
52	Review regulations to ensure adequate zoning regulations are in place to reduce future development in high-hazard areas and introduce new language to this effect in their zoning ordinances.	2	3	3	3	2	2.65
68	Prioritize list of critical facilities that are vulnerable to natural and human-made hazards and develop potential mitigation solutions for high-priority critical facilities to reduce vulnerability.	2	3	2	3	3	2.6

Table 6.4-2: Mitigation Action Prioritization							
MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA Low = 0-1.8 Medium = 1.9-2.4 High = 2.5-3					
#	Action	Effectiveness	Efficiency	Multi-Hazard Mitigation	Addresses High Risk Hazard	Addresses Critical Communications/Critical Infrastructure	Total Score
4	Install surge protectors on electronic equipment in County facilities to protect equipment during thunderstorm and lightning events.	2	3	2	3	3	2.6
5	Conduct engineering inspections of fire stations and schools to assess each facility's ability to sustain damage from flood and wind events.	2	2	3	3	3	2.5
6	Protect County buildings from hail damage by installing hail guards on roof-mounted HVAC equipment and installing hail-resistant roofing and siding when feasible on newly constructed facilities	3	2	2	3	3	2.5
53	Continue incorporating the HMP into future updates of the Charles County's Comprehensive Plan.	2	3	3	3	1	2.5
54	Introduce language in the comprehensive plan to plan for development while considering hazards and their impacts in highly developed areas.	2	3	3	3	1	2.5
55	Work with the Town of Indian Head and Lackey High School to determine ways to provide alternative access during a hazard event.	1	3	3	3	2	2.45
23	Identify opportunities to upgrade or bury power lines.	3	1	3	3	3	2.4
56	Include Historic Properties in the County's Debris Management Plan.	3	2	3	2	2	2.4
11	Continue to acquire, elevate or floodproof structures in identified repetitive loss areas throughout Charles County.	3	2	2	3	2	2.35
57	Send news releases to local newspapers, radio, and TV stations with pre-disaster information while attempting to reach all areas of Charles County.	2	2	3	3	2	2.35

Table 6.4-2: **Mitigation Action Prioritization**

MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA Low = 0-1.8 Medium = 1.9-2.4 High = 2.5-3					
#	Action	Effectiveness	Efficiency	Multi-Hazard Mitigation	Addresses High Risk Hazard	Addresses Critical Communications/Critical Infrastructure	Total Score
58	Continue to introduce environmental education programs in schools, park and recreation department, conservation associations, and youth organizations such as boy scouts/girl scouts, campfire girls, and summer camps.	2	2	3	3	2	2.35
59	Ensure access to special needs populations is provided.	2	2	3	3	2	2.35
69	Prohibit future development in high hazard areas.	3	2	2	3	2	2.35
60	Conduct Archaeological Survey of High Priority Sites in High Hazard Areas.	2	2	3	3	2	2.35
61	Create an Expedited Review Process for historic properties to be utilized post-incident	2	2	3	3	2	2.35
62	Establish a Demolition Delay Process for historic properties to be utilized post-incident.	2	2	3	3	2	2.35
63	Develop disaster plans for historic sites and resources owned by Charles County.	2	2	3	3	2	2.35
64	Conduct targeted outreach to historic property owners about mitigation techniques and recovery.	2	2	3	3	2	2.35
12	Ensure that NFIP requirements are being met concerning repairs, renovations, and remodeling of structures located in the regulatory floodplain.	3	3	1	3	1	2.3
37	Retrofit or rebuild high-priority structurally deficient bridges.	3	1	3	2	3	2.25
40	Continue inspection, maintenance, and enforcement program to help ensure continued structural integrity of dams.	2	3	1	2	3	2.25
65	Upgrade water suppression system	2	1	3	3	3	2.2

Table 6.4-2: Mitigation Action Prioritization							
MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA Low = 0-1.8 Medium = 1.9-2.4 High = 2.5-3					
#	Action	Effectiveness	Efficiency	Multi-Hazard Mitigation	Addresses High Risk Hazard	Addresses Critical Communications/Critical Infrastructure	Total Score
66	Perform outreach activities to information residents of their vulnerability to hazards and how to mitigate. This may include newsletters, flyers on keeping drain ditches clear, participation in the NFIP, and safety tips.	2	2	3	3	1	2.2
70	Encourage low density development and open space areas.	2	2	2	3	2	2.15
38	Review existing conditions of bridges to determine their susceptibility to collapse.	1	2	3	2	3	2.15
7	Promote Tornado safety public awareness and encourage the building of safe rooms during new construction.	2	2	2	3	2	2.15
13	Address flooding that is caused by an obstructed drainage ditch that runs east to west through the center of the town.	3	2	1	3	2	2.15
14	Take steps towards joining the community rating system.	3	2	1	3	2	2.15
15	Implement stormwater management and drainage improvements in flood-prone historic districts.	3	2	1	3	2	2.15
30	Plan for and maintain adequate road and debris clearing capabilities.	1	2	3	3	2	2.15
41	Regulate development near steep slopes.	3	3	1	1	2	2.15
16	Inspection of critical facilities in the 100-year floodplain conducted by a certified floodplain manager.	2	2	1	3	3	2.1
17	Identify roadways/bridges that frequently flood and mitigate to ensure ingress and egress.	2	2	1	3	3	2.1
19	Encourage immunization against diseases that can be easily communicable among residents of Charles County.	2	3	1	3	1	2.1
25	Review existing land use and development patterns near pipelines.	2	3	1	2	2	2.1

Table 6.4-2: **Mitigation Action Prioritization**

MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA Low = 0-1.8 Medium = 1.9-2.4 High = 2.5-3					
#	Action	Effectiveness	Efficiency	Multi-Hazard Mitigation	Addresses High Risk Hazard	Addresses Critical Communications/Critical Infrastructure	Total Score
26	Review pathways for potential gas or hazardous liquid migration in the event of a pipeline release and encourage land use planning and zoning controls to decrease population density in high risk areas.	2	3	1	2	2	2.1
31	Implement traffic safety improvements at high-crash intersections and roadway segments.	3	2	1	2	2	2
27	Initiate a new commodity flow study.	2	2	1	2	3	1.95
24	Prepare flyer for safety strategies during severe winter weather, including driver education classes and materials.	2	3	1	2	1	1.95
33	Continue Crime Solvers Program.	2	3	1	2	1	1.95
34	Continue offering free home and business security surveys.	2	3	1	2	1	1.95
35	Continue publishing "Watch Works" newsletter.	2	3	1	2	1	1.95
67	Create an Archaeological Context for Charles County based on a literature review of academic and historical works, and on information found in the archaeological data at the Maryland Historical Trust.	1	3	1	2	2	1.9
39	Retrofit public buildings and critical facilities to withstand snow loads and prevent roof collapse.	3	1	1	2	3	1.85
42	Apply soil stabilization measures on steep, publicly-owned slopes.	3	2	1	1	2	1.85
28	Evaluate Tier 2 facilities on an annual basis.	2	2	1	2	2	1.8
36	Encourage Crime Prevention Through Environmental Design (CPTED) principles.	2	2	1	2	2	1.8
8	Equip all County and public gathering places with lightning detectors.	2	1	1	3	3	1.8
9	Establish heating and cooling centers for vulnerable populations and link them to outreach projects that encourage at-risk populations to use the facilities.	2	2	1	3	1	1.8

Table 6.4-2: Mitigation Action Prioritization							
MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA Low = 0-1.8 Medium = 1.9-2.4 High = 2.5-3					
#	Action	Effectiveness	Efficiency	Multi-Hazard Mitigation	Addresses High Risk Hazard	Addresses Critical Communications/Critical Infrastructure	Total Score
10	Develop public awareness campaign regarding extreme temperatures and how they affect residents.	2	2	1	3	1	1.8
18	Increase awareness of homes that lie in the flood zone for prospective home buyers and residents by posting a link to the County's website that provides property-specific flood zone information.	2	2	1	3	1	1.8
20	Establish areas where vaccines and other medications could be dispensed during a public health emergency.	2	2	1	3	1	1.8
32	Develop Aircraft Emergency Disaster Plan.	2	2	1	2	1	1.65
43	Encourage structural designs that can resist loading associated with subsidence.	2	2	1	1	2	1.65
44	Identify ways to reduce vulnerability of historic properties to coastal erosion, particularly along the Potomac and Port Tobacco Rivers.	2	2	1	1	2	1.65
29	Purchase equipment necessary to sustain hazardous materials for emergency response teams.	2	1	1	2	2	1.5
45	Develop database to track landslide events.	1	2	1	1	1	1.3
46	Monitor groundwater levels and areas where natural resources are removed underground.	1	2	1	1	1	1.3
47	Inform the public about defensible space and how to reduce their risk to fire.	1	2	1	1	1	1.3
Actions highlighted in green are new for the 2018 HMP Update.							

CHAPTER 7: PLAN EXECUTION AND MAINTENANCE

7 PLAN EXECUTION AND MAINTENANCE

7.1 Monitoring, Evaluating, and Updating the Plan

Monitoring, evaluating, and updating this HMP is critical to maintaining its value and success in Charles County's hazard mitigation efforts. Ensuring effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. This section explains who will be responsible for maintenance activities and what those responsibilities entail. It also provides a methodology and schedule of maintenance activities including a description of how the public will be involved on a continued basis. The HMPC decided to keep the methodology and schedule similar to what was outlined in the 2012 HMP, but to put more emphasis on integrating the mitigation goals, objectives, and actions identified in the Mitigation Strategy into the other ongoing planning efforts to ensure implementation and tracking of actions throughout the five-year plan maintenance process.

The Charles County Department of Emergency Services is designated to lead plan maintenance processes of monitoring, evaluation and updating with support and representation from all participating municipalities. The Department of Emergency Services will coordinate maintenance efforts, but the input needed for effective periodic evaluations will come from community representatives, local emergency management coordinators and planners, the general public, and other important stakeholders. In addition, the Department of Emergency Services will serve in an advisory capacity to the Charles County Board of Commissioners and other Departments within the County.

Each jurisdiction will designate a community representative to monitor implementation of mitigation activities and hazard events within their respective communities. This individual will be asked to work with the Charles County Mitigation Planning Committee to provide updates on applicable mitigation actions and feedback on changing hazard vulnerabilities within their community. In addition, the jurisdictional monitor will be responsible for reviewing the planning and land use regulatory element of the community's capability assessment to identify potential opportunities for incorporating appropriate elements of this HMP into local planning mechanisms and will also identify locally generated plans, information, reports, etc.

Similarly, the Charles County Department of Planning and Growth Management will lead the effort to integrate mitigation goals, objectives, and actions into County comprehensive planning efforts. While the Comprehensive Plan will not include detailed information from the risk assessment and mitigation strategy, the HMP will continue to be referenced to ensure this information is addressed in comprehensive planning process. The Department of Planning and Growth Management will also take the lead with several actions related to further evaluating historic and cultural resources. The Department of Planning and Growth Management will report to the HMPC the progress of these actions and will identify if there are changes that need to be made to the risk assessment or the mitigation strategy based on information developed during the comprehensive planning process.

The Department of Emergency Services will oversee the progress made on the implementation of action items identified and modify actions, as needed, to reflect changing conditions. The Charles County Department of Emergency Services will meet annually to evaluate the plan and discuss specific coordination efforts that may be needed with participating jurisdictions and other stakeholders. The annual evaluation may include the participation of individual municipal monitors, or at least will include reports prepared by them.

The annual evaluations of the 2018 HMP will not only include an investigation of whether mitigation actions were completed, but also an assessment of how effective those actions were in mitigating potential losses. The annual reviews will be led by the Chief of the Emergency Management Division. A review of the qualitative and quantitative benefits (or avoided losses) of mitigation activities will support this assessment. Results of the evaluation will then be compared to the goals and objectives established in the plan and decisions will be made regarding whether actions should be discontinued, or modified in any way in light of new developments in the community. Progress will be documented by the HMPC for use in the next HMP update and submitted to the Charles County Department of Emergency Services.

This Plan will be updated by the approved five-year anniversary date, as required by the Disaster Mitigation Act of 2000, or following a disaster event. Future plan updates will account for any new hazard vulnerabilities, special circumstances, or new information that becomes available. During the five-year review process, the following questions will be considered as criteria for assessing the effectiveness of the Charles County Hazard Mitigation Plan.

- Has the nature or magnitude of hazards affecting the County changed?
- Are there new hazards that have the potential to impact the County?
- Do the identified goals and actions address current and expected conditions?
- Have mitigation actions been implemented or completed?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Are current resources adequate to implement the plan?
- Should additional local resources be committed to address identified hazards?

Issues that arise during monitoring and evaluation which require changes to the local hazard, risk and vulnerability summary, mitigation strategy, and other components of the plan will be incorporated during future updates.

Any interested party wishing for an update of the HMP sooner than the 5-year update will submit such a request to the Charles County Department of Emergency Services for consideration through the Chief of the Emergency Management Division. The request shall be accompanied by a detailed rationale. The Charles County Department of Emergency Services will evaluate all such requests and determine whether the update request should be acted upon. If the decision is in the affirmative, an assignment will be made for an individual to author the update. The draft updated section along with a detailed rationale will be submitted to the Charles County HMPC. The committee will circulate the draft updated section to every jurisdiction participating in the plan for comment and after an appropriate period of time, the committee shall make a decision to update the plan at least partially based on the feedback received from the other jurisdiction. County and municipal adoptions will then occur.

7.2 Continued Public Involvement

As was done during development of the 2018, 2011, and 2006 HMP Update, the HMPC will involve the public during annual meetings or periodic evaluations of the HMP by providing an opportunity to submit comments. The public will have access to the current HMP through their local municipal office or on the Charles County Department of Emergency Services. Information on upcoming events related to this Plan or solicitation for comments will be announced via newsletters, newspapers, mailings, and the County website which can be accessed at: www.charlescountymd.gov/es/em/emergency-management. The public is encouraged to submit comments on the HMP at any time. The HMPC will incorporate all relevant comments during the next update of the Charles County HMP.

CONCLUSION

As a result of initiating the hazard mitigation planning process, Charles County officials have obtained a great deal of information and knowledge regarding the County's disaster history, the presence of natural and human-made hazards, the likelihood of each of these hazards occurring within the County, and the potential impacts, losses, and challenges these hazards present to the community.

The general planning process picked up from where the 2012 HMP left off with the identification and re-evaluation of hazards that have occurred within Charles County throughout the past. This was followed with data collection throughout the County and within its communities. It was determined that several new hazards should be profiled in the 2018 HMP and that further analysis should be given to the vulnerability of the County's historic and cultural resources. Assessments were then made to determine the vulnerability of the community, structures, critical facilities, populations, and historic and cultural resource to various hazards, and to determine hazard-specific losses. After an evaluation risks, vulnerabilities, and potential losses within the community, mitigation goals, objectives, and related action items were then re-evaluated and prioritized.

The planning process included the re-convening of the Charles County Mitigation Planning Committee. Three meetings were conducted with the Hazard Mitigation Committee, and an additional meeting was conducted with the Board of Charles County Commissioners. Meetings were advertised publicly providing Charles County citizens with the opportunity to comment on, and offer suggestions concerning mitigation actions within the community. Additionally, a 30-Day Comment Period was provided for the public to review the plan.

The mission of the Charles County Mitigation Planning Committee for this 2018 Hazard Mitigation Plan was similar to that of 2012 and 2006:

> *To make the citizens of Charles County less vulnerable to the effects of hazards through a coordinated effort by identifying risks, community vulnerabilities, developing wise mitigation strategies, and seeking hazard mitigation grant funding to implement chosen strategies.*

The committee feels that this HMP update, when implemented, will help to make all of Charles County a safer place to live and work for all of its citizens.